California. Dept. of Fish and Game.
Biennial Report 1928-1930.

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DATE	ISSUED TO

STATE OF CALIFORNIA

DEPARTMENT OF NATURAL RESOURCES

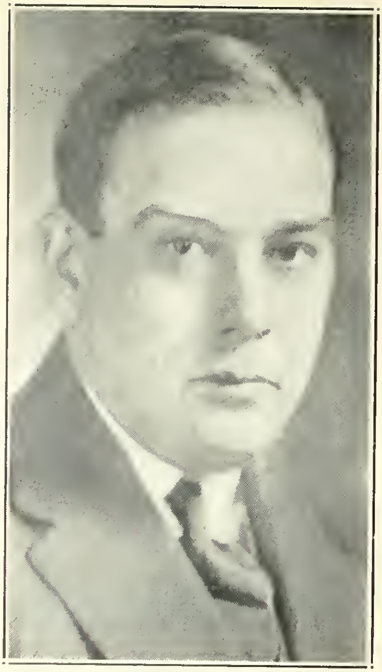
Division of Fish and Game

THIRTY-FIRST BIENNIAL REPORT

For the Years 1928–1930

81166

I. ZELLERBACH, Fish and Game Commissioner, President.



REGINALD G. FERNALD, Fish and Game Commissioner.

JOHN L. FARLEY, Executive Officer.

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LETTER OF TRANSMITTAL

San Francisco, September 30, 1930.

His Excellency C. C. Young,
Governor, State of California,
Sacramento, California.

Sir: In compliance with law we submit herewith a report of the activities and accomplishments of the Division of Fish and Game for the biennial period from July 1, 1928, to June 30, 1930.

This report consists of a summary by the executive officer, and also detailed reports of the several bureaus of the Division, and in the appendix a complete statistical statement.

We wish to take this means and opportunity to express our appreciation for the considerate interest manifested in and the helpful cooperation extended to this Division by Your Excellency, the members of the legislature, the officers and several departments of the state government during the past biennium.

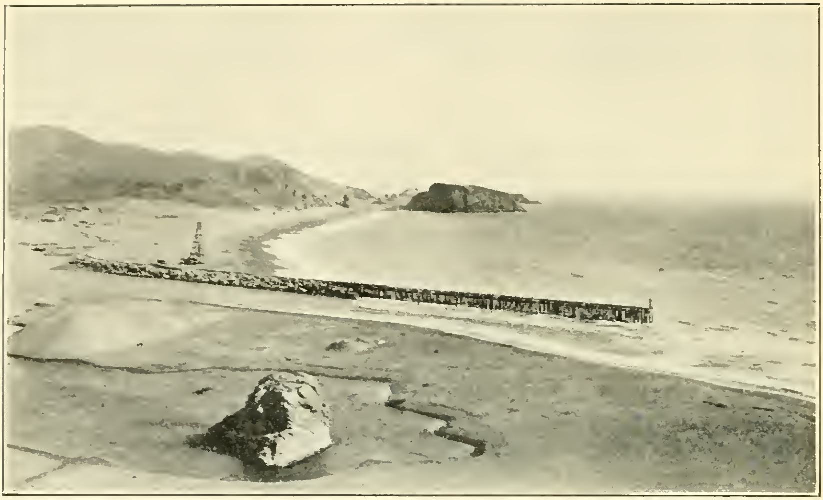
Respectfully submitted.

I. Zellerbach,
Reginald G. Fernald,
Chas. R. Bell,
Fish and Game Commission.

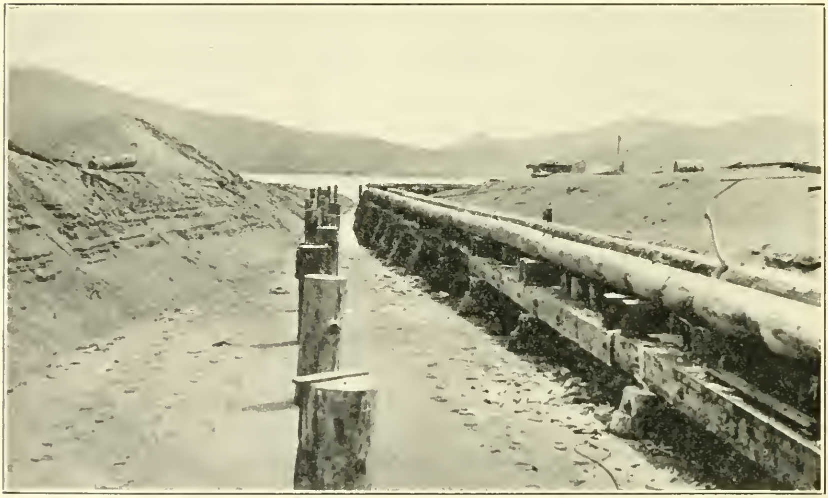
In Memoriam

Listed here are those faithful, self-sacrificing workers for conservation who, through death during the past biennium, have left their work and their spirit to other hands.

	Entered Service	Died
W. Armstrong	April 1, 1907	November 21, 1929
E. D. Ricketts	October 1, 1910	January 4, 1930
Allan Curry	August 1, 1929	April 30, 1930
G. O. Laws	February 1, 1908	June 9, 1930



Russian river jetty—August 9, 1930. Looking south from county road, showing entire jetty, railroad and quarry.



Russian river jetty—August 30, 1929. Core wall and railroad timber construction through bar.

THIRTY-FIRST BIENNIAL REPORT

REPORT OF EXECUTIVE OFFICER

Honorable Board of Fish and Game Commissioners
of the State of California,
San Francisco, California.

Sirs: During this biennium the personnel and organization of the Fish and Game Commission, with Mr. I. Zellerbach, of San Francisco, as president, and Mr. R. Fernald, of Santa Barbara, and Mr. Geo. B. Clarkson, of Los Angeles, as members, continued unchanged until April 1, 1930, when the resignation of Mr. Clarkson was accepted by the Governor. The vacancy continued unfilled during the remaining three months of the biennial period.

On April 1, 1929, Mr. Eugene D. Bennett resigned as executive officer of the Division of Fish and Game, and the undersigned, who had been previously employed as Mr. Bennett's assistant, was appointed executive officer. Mr. Bennett continued to act as attorney for the Division.

The other more important changes in the administrative personnel included the appointment of Mr. E. L. Macaulay as chief of the Bureau of Patrol on January 1, 1929, and the resignation of Dr. Harold C. Bryant as head of the Bureau of Education and Research, effective the last day of the biennial period. Dr. Bryant left the division to accept an appointment as director of the educational work of the National Park Service, a work which he effectively organized in Yosemite National Park as one phase of the educational work of this division.

Following the resignation of Mr. Frank Vore on December 31, 1929, as head of the Bureau of Publicity, the work of that bureau was continued with the Bureau of Education and Research.

During the biennium the work of the Division of Fish and Game has continued along the same general lines established during the preceding two bienniums. Each bureau has been allotted definite amounts of money to carry out the work assigned, and each bureau head has been held accountable for efficient operation within these funds.

Realizing that the field men of the division determine largely the effectiveness of the policies which have been adopted by the Fish and Game Commission, every effort has been made to build up the high standard which has been previously maintained. The Civil Service Commission has conducted examinations to establish eligible lists, and during the six months' probationary period of new employees we have endeavored to make certain that all men finally selected for permanent employment would be a credit to our service. All too few people

realize the arduous nature of the work required of our deputies, fish hatchery assistants, cannery inspectors, and game farm employees. High grade men are essential if our work is properly done, and we are justly proud of the men who make up our organization. It is believed that the salary scales established for certain of our activities should be raised to attract the type of men needed.

Notable accomplishments during the biennium include the purchase and development of a 3000-acre refuge for migratory waterfowl in the San Joaquin Valley, near Los Banos; the completion of the *Bluefin,* a new seagoing patrol boat for the Bureau of Commercial Fisheries, specially equipped for scientific research; the completion of the Los Serranos Game Farm, near Chino, San Bernardino County; the completion of the Navarro River jetty; the construction of the Yuba River

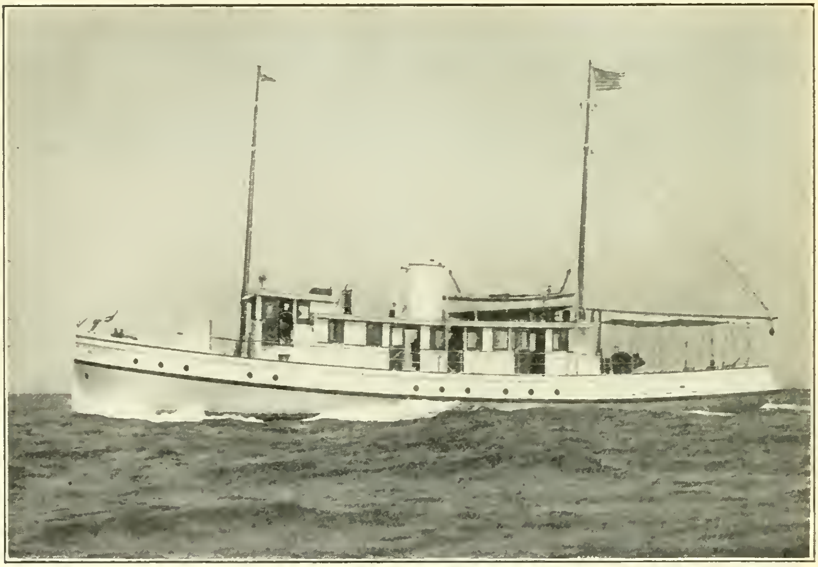


FIG. 1. New patrol boat, *Bluefin.* Photography by D. H. Fry, Jr., August 27, 1930.

Hatchery, and two series of rearing ponds in the southern part of the state; and the planting of striped bass in the Salton Sea.

The division has continued to contribute to, and work with, the Hooper Foundation for Medical Research of the University of California, in the study of problems relating to the fish canning industry, and the control of diseases of game birds, animals and fishes. Financial assistance and cooperation has been given to the State Board of Health in the work of stream pollution studies and prevention, and other cooperative work has been carried on with Stanford University in the study of marine problems.

Where other state or federal agencies have facilities and trained personnel to carry on highly specialized investigations, it has been the policy to arrange for use of these facilities rather than to set up a duplicate and less effective organization to attempt to accomplish the same result.

Special attention has been given to the investigation of damage being done to orchards and other growing crops by deer and game birds. Some effective and inexpensive control methods have been developed, and it is hoped that continued study will further solve this perplexing problem.

All moneys used in the operation of this division come from the fish and game preservation fund, to which fund is credited all money received from the sale of licenses, deer tags, and the tonnage tax imposed upon the commercial fisheries industry, and from fines imposed for the violation of the fish and game laws. The division is self-supporting, operating entirely within its income, no money being received from the general fund of the state.

It may be of interest to note the main sources of income, and the following chart shows this for the past twenty years:

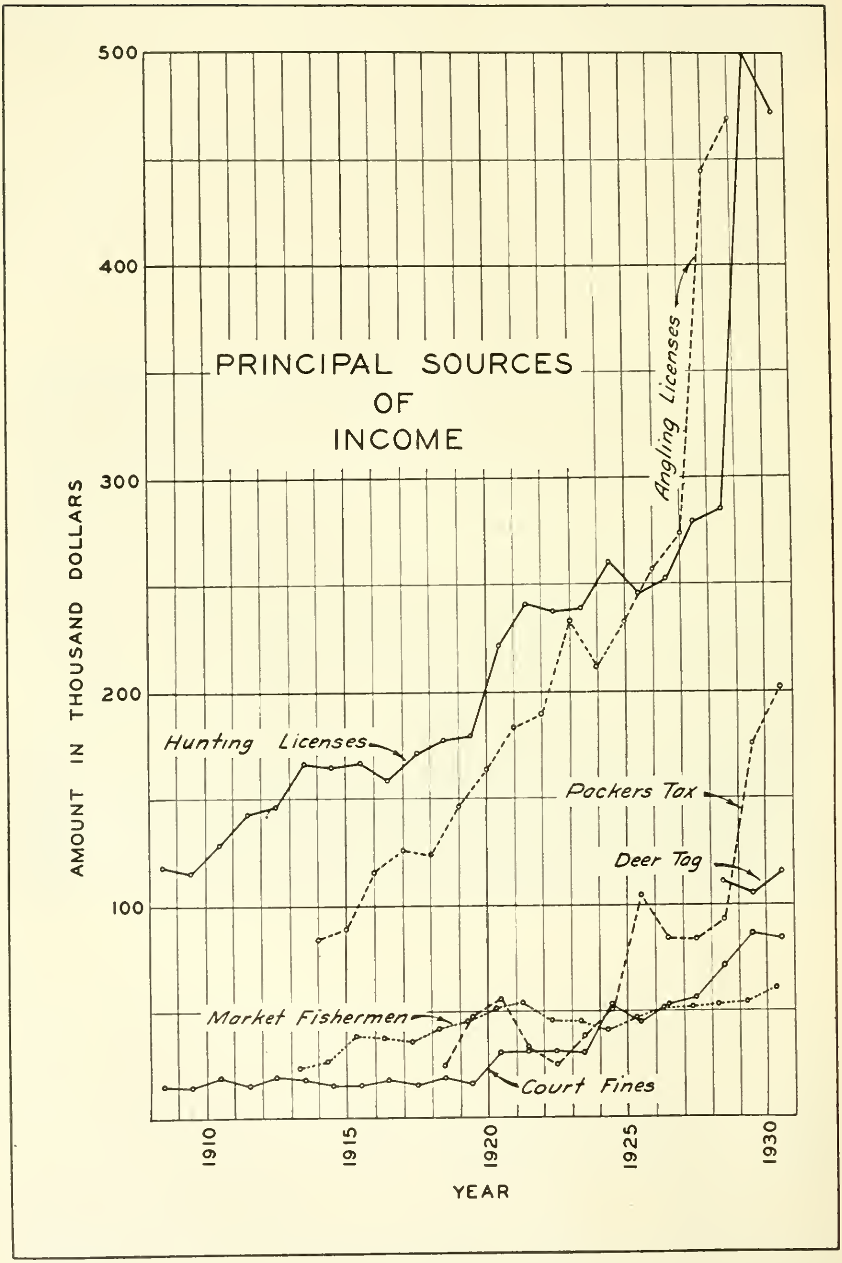


Fig. 2. Principal sources of income.

Following is a brief summary of the work of the division by bureaus:

LICENSE SALES

Licenses have continued to be distributed through the county clerks of those counties where the work can be effectively handled by this method. In other counties, licenses are distributed directly to the dealers from the offices of the division. It is believed that a uniform system of license distribution should be worked out which will apply throughout the state. It is probable that some changes in existing legislation will be necessary to work this out satisfactorily.

During the calendar year ending December 31, 1928, 228,696 hunting licenses were sold, yielding a revenue of $466,145, and during the calendar year ending December 31, 1929, 241,447 hunting licenses were sold, yielding a revenue of $488,114. During this same two years the number of angling licenses sold were 216,738 and 229,374, yielding a revenue of $443,660 and $469,442, respectively.

The deer tags sold in 1928 and 1929 totaled 105,638 and 115,472, yielding a revenue of an equal number of dollars.

The other principal sources of income were the sale of market fishermen's licenses, amounting to $31,320 and $30,970, for the fiscal years ending in 1929 and 1930; the fish packer's tax of 50 cents per ton, amounting to $175,805 during the same period, and court fines for fish and game law violations, amounting to $171,652.68.

The total income from all sources for the eightieth fiscal year amounted to $1,402,317.38, with total expenditures of $1,052,938.37; and during the eighty-first fiscal year the total revenue amounted to $1,431,733.21, with total expenditures of $1,299,906.87.

COMMERCIAL FISHERIES

There was a notable increase in the amount of fish and shellfish caught and landed in the state during the past two years. This increase amounted to 62 per cent over the receipts during the previous two-year period. The sardine fishery continued to be the largest and most important in the state, over 1,072,000,000 pounds being landed in the past two years, which represented an increase of 70.4 per cent over the preceding period.

The increase in the importance of mackerel as a canned fish has been very marked. In 1928 mackerel jumped from tenth place in importance among our fisheries to second place. A total catch of less than 5,000,000 pounds in 1927 was increased to 35,000,000 in 1929.

The product of the fish packing plants, together with the value of the fresh fish disposed of, amounts to between thirty and forty million dollars annually.

While the increased catch has been notable, the increase has not been in proportion to the increase in effort and the improvement of fishing gear. The decreasing ratio between the tonnage of fish received and the effort expended to secure it, sounds a note of warning which must be considered carefully in plans to perpetuate our important commercial fishing industry.

In accordance with a resolution adopted during the last session of the legislature, and in accordance with a long standing practice of this division, contacts have been maintained with fishery officials of Oregon,

Washington, and with the federal government, in an endeavor to secure a workable plan of uniform restriction for controlling salmon trolling. Seasons have already been established in this state, and meetings have been held with a committee of Oregon legislators, members of the California Fish and Game Study Committee, and this division. Future meetings have been arranged, and the outlook is quite hopeful for the adoption of a closed season in the state waters to the north.

The Fish and Game Investigating Committee appointed by the last legislature, consisting of Assemblyman Wm. P. Jost, as chairman, and Assemblymen Harry F. Morrison and Henry McGuinness, has been most helpful in assisting this division in gathering information, and in studying the more serious problems of fish and game conservation.

FIG. 3. A network of barren lakes and streams were stocked with golden trout in the granite basins below Cartridge Pass, Fresno County, California. Photo by F. A. Bullard, July, 1929.

The Fisheries Laboratory at Terminal Island has continued the collection of statistics, its study of fishing areas and the supply of important species, and its analysis of the data which have been gathered. The results of these investigations which have been completed have been published in sixteen bulletins, which had been issued, or were on press at the close of the period covered by this report.

BUREAU OF PATROL

The Bureau of Patrol continued to be one of the most important phases of our work. This law enforcement body at present consists of 102 deputies, 16 captains, 2 supervising captains, and a chief of patrol. In part, the effectiveness of this group is indicated by the number of arrests made and the amount of fines secured, which total 5388 arrests, and $171,652.68 fines during the two-year period. However, the effi-

ciency of this group is not judged entirely by their records of arrests and convictions, and special stress is given to the prevention of violations by work in and through various civic organizations.

The members of this bureau are also held responsible, with the Bureau of Fish Culture, for the successful planting of the fish hatched and reared in our hatcheries. This fish planting has constantly improved as the men involved have become more familiar with the work.

Our patrol force has worked closely with members of the U. S. Forest Service, and with the State Forest Service, in the prevention and suppression of forest fires.

VOLUNTEER DEPUTIES

The work of the volunteer deputies has continued under the leadership of Captain Walter R. Welch, of the Bureau of Patrol, and a great deal of assistance has been received from these volunteers, who are mainly sponsored by sportsmen's organizations. In addition to those so sponsored some three hundred appointments have been made among the federal employees who are working in this state as representatives of other conservation bodies, chiefly the U. S. Forest Service.

Great care has been taken in the selection and instruction of the volunteer deputies, and much good has been accomplished by their work in securing the observance of our state fish and game laws.

The volunteer deputies have also sponsored a movement to create quail sanctuaries throughout the state, and to assist in the control of predatory birds and animals on these sanctuaries.

The interest of this group in the work is attested by their record of over 1,000,000 miles of patrol of field, streams and coast lines; by the checking of over 80,000 licenses, and by their assisting in arresting 586 game law violators, which cases have resulted in fines amounting to over $20,000.

Further evidence of their serious interest in the work is indicated by the attendance of a large number of volunteer deputies at annual conventions which have been held in San Francisco during April of each year. Representatives were present from nearly every county of the state, and the entire expenses of the conventions have been borne by the deputies and those who contributed to the support of their work.

FISH PLANTING

As mentioned above, the responsibility for the successful planting of fish from our hatcheries has been placed with the Bureau of Patrol, assisted by the Bureau of Fish Culture. During the past two years, to insure close cooperation of these bureaus, a properly qualified assistant has been assigned to the work from the Bureau of Fish Culture, and the work has progressed with marked smoothness and effectiveness.

Sportsmen's organization, the Federal Forest Service, the National Park Service, and a number of county governments have continued to assist the division in the fish planting program; in fact, without the gratuitous assistance given it would be impossible to adequately plant the large number of fish which are now being raised, during the short periods of time which are available for this work.

We wish to take this opportunity to express our appreciation of this assistance, and to the Southern Pacific, the Western Pacific, the Santa Fe, Northwestern Pacific, the Sacramento Northern, and other transportation companies which have so generously transported, without cost, fish cars, fish cans, and the hatchery personnel necessary for the distribution of the product of our hatcheries. This very material assistance makes possible other work which could not otherwise be undertaken.

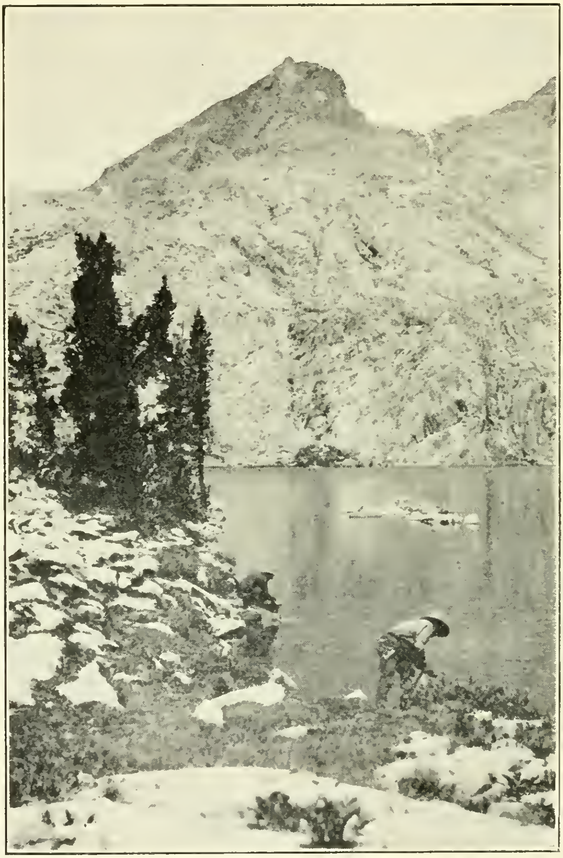


FIG. 4. Extending the range of golden trout to the headwaters of Goddard Creek, Fresno County, California. Photo by F. A. Bullard, July, 1929.

FISH CULTURE

During the past two years the Yuba River Hatchery and the Snow Creek Hatchery have been completed, and rearing ponds have been constructed on the San Gabriel River and on Snow Creek. The rearing ponds are of particular interest, as they are being used as a basis of study to determine the cost and the effectiveness of rearing fish to a catchable size before planting.

This bureau has successfully operated 28 hatcheries and 15 egg-collecting stations during the biennium, producing over 62,000,000 trout, varying from $1\frac{1}{2}$ to 4 inches in length, and 10,000,000 salmon. At the close of the period covered by this report 35,000,000 trout were on hand for the 1930 distribution.

The success of the work of this bureau is indicated by the insistent demand for additional hatcheries, but it is felt that rather a definite limit has been reached in the expenditure of funds for fish cultural work from the revenues which are now being received.

The problem of securing eggs is becoming exceedingly difficult with the continued periods of low precipitation. Added to this is the feeling which exists in several sections that all eggs taken from any stream system should be returned to the same system. Inasmuch as it is well

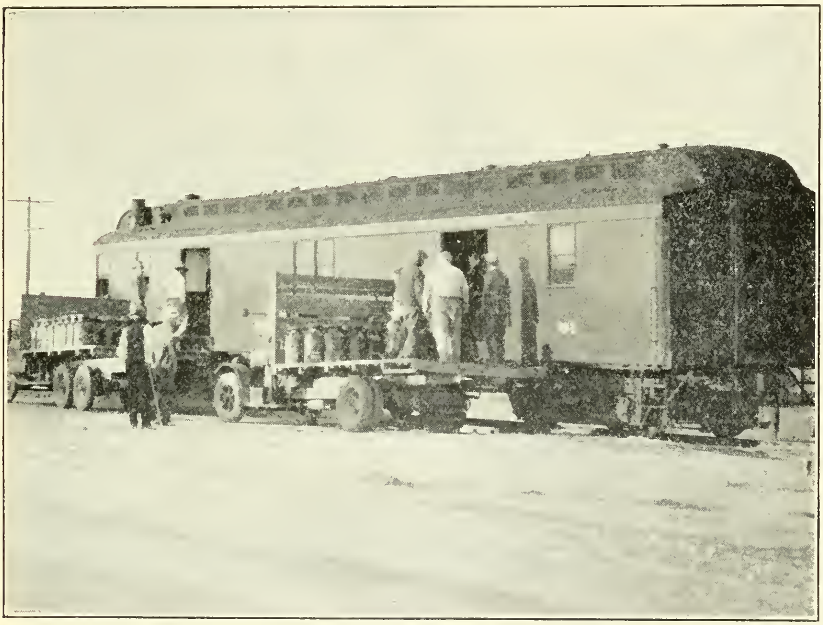


FIG. 5. Unloading bass at Calipatria, Imperial County, California, for stocking Salton Sea. Photo courtesy of Robert Hays, October, 1929.

established that from 70 to 80 per cent of the eggs taken by artificial methods are successfully hatched and reared to sizes suitable for planting, as contrasted with evidence that only from 3 to 5 per cent of the eggs from natural spawning produce fish of a similar size, it is our opinion that the Commission is well justified in releasing to other portions of the state eggs taken in any of our stream systems as long as there are successfully planted in the parent streams more fish than would have been naturally produced had no egg-taking operations been undertaken.

FISH RESCUE

The Bureau of Fish Rescue has continued its program of saving, as far as possible, all fish stranded by receding waters or endangered by

law water conditions or by abnormally high water temperature. The fish so rescued have been partly returned to adjacent waters, and partly distributed to other sections of the state where the greatest good could be accomplished. During the past two years nearly 7,000,000 fish have been rescued and distributed.

In order to have available a group of trained men, with proper equipment, all seining permits to commercial fishermen for the removal of nongame fish are issued with the provision that the permittee will make

FIG. 6. Conveying striped bass to planting grounds, Salton Sea. The boat is equipped with airplane motor, propeller and aerial rudder so as to speed over the shallow flats. Photo courtesy of Robert Hays, October, 1929.

available both his equipment and employees at any time when rescue work is necessary.

To this bureau, and the Bureau of Fish Culture, goes the credit for the successful gathering and transplanting of two carloads of striped bass from the great valleys to the Salton sea. Recalling the remarkable development and spread of these fishes from the two small plantings originally made in the San Francisco Bay region, and with the knowledge that the water and food conditions of Salton sea are favorable to these fish, it is hoped that this trial will result in the development of an important supply of game and food fish in the Salton sea.

GAME REFUGES

In order to more effectively handle the large areas which have been set aside in the state for game refuges, and to administer those refuges which are purchased from funds set aside by legislative act from the sale of hunting licenses, a Bureau of Game Refuges was created. To this bureau has also been assigned the work of predatory animal control.

Over two and one-half million acres have been set aside by legislative act, one 3000-acre refuge in the San Joaquin Valley for migratory waterfowl has been purchased, and other similar areas are being considered in order that there may ultimately be a chain of refuges extending from the northern to the southern part of the state, for those birds which are so obviously in need of assistance during this time of an increasing number of hunters, and decreasing breeding and feeding grounds.

During this biennium bounties were paid on 622 lions, and studies have been made and are being continued to determine the most effective methods of controlling the other predators. The assistance given by other federal, state and county agencies is outlined in detail in the report submitted for this bureau.

It is gratifying to the hunter to know that the supply of deer in the state, under existing laws, seems to be assured, and there are very definite indications of an increase in these animals in a number of sections. It is probable that there are between four and five hundred thousand deer in the state.

The herd of tule elk which has ranged in the Buttonwillow section of Kern County has been increasingly troublesome to the property owners since this area has been subdivided and sold in small lots, and developed for cotton and other valuable crops. All efforts for a cooperative project to provide a refuge for these animals have so far failed. Something definite must be done within the next two years if this herd of elk is to be preserved. The whole burden of such refuge should not be borne by the sportsmen who furnish the funds for this division, as the elk are to be preserved for sentimental reasons rather than to furnish game for our hunters. Another herd of these elk have been causing considerable trouble in Yolo County, and the herd of Roosevelt elk in Humboldt and Del Norte counties have been the source of considerable complaint from ranchers near Orick.

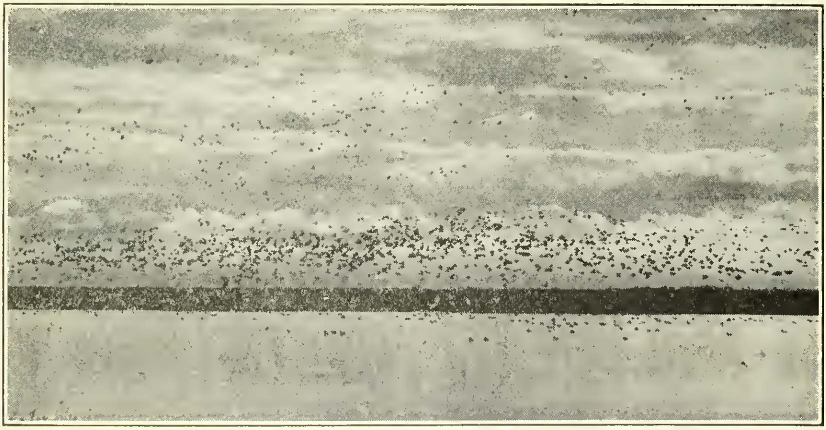


FIG. 7. Hundreds of ducks alighting on Big Buttonwillow Lake, on state waterfowl game refuge near Los Banos. Photo by E. S. Cheney, December, 1929.

GAME FARMS

The Los Serranos Game Farm was completed and appropriately dedicated in December, 1929, with an attendance of over 7000 visitors and a program arranged jointly by the Izaak Walton League of America, the Associated Sportsmen, and representatives of this division.

The farm is of particular interest because of its all-steel construction. The land occupied by this farm was donated to the state by the Los Serranos Country Club.

Great progress has been made on our farms in the use of electric brooders and incubators, and this work has received nation-wide atten-

tion. It has been found that properly designed electric equipment will hatch and brood our game birds with fewer losses, with less expense, and with greater opportunities to completely control diseases than is the case where domestic poultry is used. Game birds are very susceptible to domestic poultry diseases, and regular tests and inspections are made to make certain that our stock is kept in a healthy condition, and that diseases are not transmitted throughout the state by our stocking program.

The choice of, and the planting of introduced species is carefully checked to prevent the crowding out of any of our desirable native birds. In addition to this, arrangements are now being matured for the use of our game farm facilities in building up the supply of native quail.

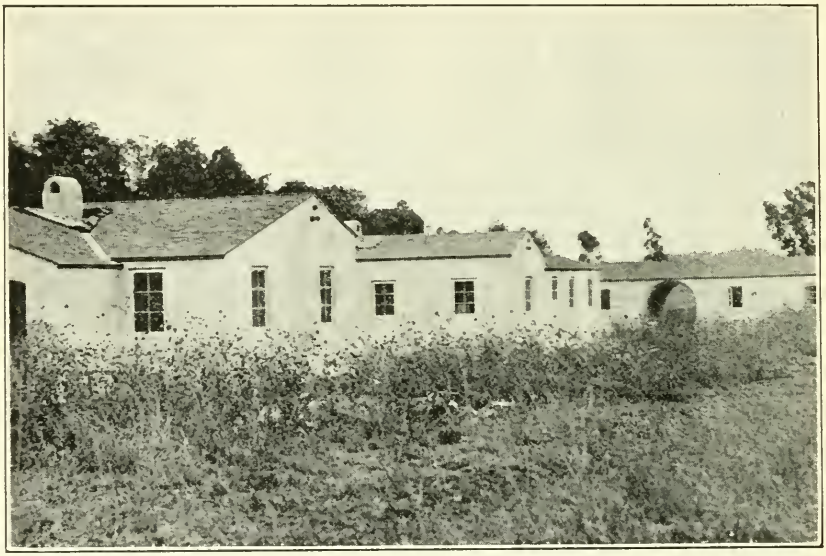


FIG. 8. Buildings for help and the incubator house, all of Spanish architecture at the new Serranos Game Farm, at Chino.

The superintendent of our game farms is held responsible for the success of all plantings, and all distribution is made after a careful investigation on the part of those familiar with the requirements of the birds to be planted. During the biennial period over 15,000 ring-necked pheasants, 1500 Hungarian partridges, and 358 wild turkeys have been distributed and planted in various parts of the state. In addition to the above, over 6000 pheasant eggs have been distributed to clubs and private individuals who are equipped to properly hatch and rear them, and who will later plant them in appropriate areas.

EDUCATION AND RESEARCH

This bureau has continued its program of "Conservation through education" by the production and distribution of motion pictures depicting our wild life; by giving lectures before 125,000 people; by displays and exhibits at state, county, and other fairs; through the

assembling of material and the editing of our quarterly publication, California Fish and Game; the preparation of a monthly employees' bulletin; the release to the press of publicity covering the division's activities, and the maintenance of an excellent library of books, periodicals, and other publications dealing with fish and game and related subjects.

Our research activities have continued, with the aid of the Hooper Foundation for Medical Research, in diseases of fish and game. Notable advances have been made in the study of duck diseases, deer parasites, quail diseases, and the prevention of deer and game bird damage.

HYDRAULICS

While progress has been made in the installation of fish screens and ladders, there is still a large group of organizations and individuals who resist the efforts of the Commission to prevent the loss of fish to the waters of the state by the installation of screens in canals, and to insure the passage of migratory fish to spawning areas by the installation of fish ladders. While existing legislation properly provides that those who receive the benefit of the diverted water must protect the state from the loss of fish life, there is still a strong feeling that this protection (screens and ladders) should be paid for by the sportsmen who are being deprived of fishing areas by the water diversions.

The Bureau of Hydraulics has continued its effective work in the prevention of oil pollution, and splendid cooperation has been received from many of the oil operators. It is estimated that the oil industry has expended in the neighborhood of $4,000,000 during the past three years in the prevention of oil pollution.

LEGAL BUREAU

The legal work of the division has continued to be greatly varied in character, and includes the prosecution of civil actions in the superior courts in matters relating to water pollution, fish screens and ladders, and the preservation of fish and game; the defense of all actions instituted in federal, superior and other courts against the division, the Commission, or its employees acting in their official capacities; assisting the deputies of the division in the prosecution of criminal cases in justice and police courts for fish and game law violations; rendering opinions to employees of the division, and to other individuals and organizations who desire an interpretation of the fish and game laws; and the preparation of leases, agreements, and other instruments required for the work of the division.

The reports of the bureau heads are reproduced on the following pages, as submitted by them, even though in some cases their recommendations have not yet been approved by the Commission. It is believed that the interests of the state are best served by such a record of the conclusions which have been reached by these trained observers.

Respectfully submitted.

John L. Farley,
Executive Officer.

REPORT OF THE BUREAU OF FINANCE AND ACCOUNTS

By H. R. Dunbar, in charge

The Division of Fish and Game is a self-supporting commission, deriving its revenue from certain kinds of licenses that come under its control, fish packers' tax, fines imposed in the justice courts for violations of fish and game laws, and from various miscellaneous sources.

The work of this bureau is principally to supervise the printing and distribution of licenses throughout the entire state, to see that remittances are made on the sale of same and at the expiration of each kind of license, to obtain settlements from all county clerks and agents so that a full and final accounting can be made with the State Controller. At the present time there are about 2000 agencies selling licenses in the state.

The county clerks make remittances direct to the State Treasurer, accounting for same to the State Controller, the Controller then notifying this office of each remittance so that the particular account of each county clerk can receive credit. All other remittances for license sales are made direct to this office and this office is required, at the end of each month, to make a remittance of all moneys received during the month, to the State Controller. Fines imposed in the justice courts are remitted direct by the justices to the State Treasurer. The fish packers' tax, which is paid by the fish packers and canners, is remitted to this office through the Bureau of Commercial Fisheries at San Francisco, which office attends to the collecting of same.

In May of 1929, an unfortunate circumstance arose when it was found that the county clerk of Mendocino County was unable to make a final accounting on his 1928 hunting and angling license accounts and on the early sales on these two accounts for 1929. Shortly after this the grand jury of that county convened and indicted him on four counts. Later he was tried before the superior court and as a result was found guilty on two of the counts. This is the first instance that a county clerk failed to make an accounting in full in over eighteen years.

The value of licenses distributed throughout the state each year amounts to approximately one million dollars. When the hunting license law was first enacted in 1907, license distribution was made solely through the county clerks, but after a number of years it was found that in some counties proper distribution was not being made and as a result the law was amended, permitting the Fish and Game Commission to distribute licenses direct wherever the occasion required. This condition also applied to the angling licenses in later years. As time went on, certain county clerks were handicapped in the distribution of licenses for the reason that they were required to remit into the county treasury all fees received by them in accordance with certain county charters and county governmental legislation. In 1927, when the citizen hunting and angling licenses were increased from $1 to $2 each and the deer tag law was enacted, the commission allowed on the

sale of the same was decreased from 10 per cent to 5 per cent, resulting in several county clerks requesting that they be relieved of the distribution in their county. Other county clerks would not distribute licenses unless the agents paid cash in advance and in other counties the county clerks would not give any of their agents a part of the commission received by them for the sale of licenses. Altogether, the Division of Fish and Game is distributing at least half of the hunting, angling and deer tag licenses direct to agents in the state and many complaints have been registered with the division by agents handling licenses from the county clerks, expressing themselves as being dissatisfied with the present arrangements. This office realizes that under present conditions the system of license distribution that we are now working under is not giving entire satisfaction throughout the state. We are giving consideration to various suggestions relative to improving our system that would enable the division to distribute licenses throughout the state to the satisfaction of all of the agents as well as the sportsmen and at the same time guarantee the return of all moneys received from the sale of licenses for remittance to the State Treasurer. When one realizes the large value of licenses to be distributed, it is apparent that considerable study must be given in the formulation of new plans. It is our hope to be able to have the law amended at the next session of the state legislature.

There are eleven separate kinds of licenses that come under the control of the Division of Fish and Game, which are as follows: Hunting, angling, deer tag, commercial fishing, trapping, fish breeders', fish importers', game breeders', fish packers' and wholesale shell fish dealers', kelp, commercial hunting club, and commercial hunting club operators' licenses. The hunting, angling and deer tag licenses are the three most important and represent the bulk of the total license revenue. In the past, these licenses have been given wide distribution with agents in practically every town in the state, so that it has been possible for the sportsmen to readily obtain them. The commercial fishing and trapping licenses are distributed to only a few centrally located agents, and the bulk of these license sales are made in the offices of the division.

The following is a brief summary of each kind of license, also of other sources of income received by this division:

HUNTING LICENSES

Prior to 1907, the Fish and Game Commission received an appropriation from the state legislature for the purpose of carrying on its patrol and fish culture work. In that year certain persons who were interested in the wild life of the state realized that the fish and game were being depleted and that additional funds were needed to carry on this work. It was supposed that persons engaged in hunting should bear the burden of this expense so in that year the hunting license act was passed by the state legislature and became effective immediately.

This license was divided into three classes, namely: Citizen-resident at $1, nonresident at $10 and aliens at $25. A few years later the law was amended permitting aliens, who had taken out their first papers for citizenship, to take out a license for $10. The first year that this license was effective, there were 113,975 licenses sold for a value of

$118,427. Each year thereafter the slight variations in the sale showed a decided increase. It will be noticed from the appended chart that in the year 1919–20, which was immediately after the close of the world war, the sale showed an increase of $42,496 over the year previous. During the past twenty years the number of persons who have gone into the field, either hunting or fishing, have more than doubled. Also many new roads have been constructed and the federal government has built good trails in the mountains, making it possible for sportsmen to enjoy excellent hunting and fishing within a few hours drive. During this period the hatcheries were taxed to the utmost in raising fish to be planted in streams and lakes, and the patrol force needed enlarging in order to properly patrol the state. In order that this work could be accomplished it was necessary to increase the citizen-resident license fee on both the hunting and angling licenses from $1 to $2 each. At the 1927 session of the state legislature a new hunting and angling license law was passed, increasing the citizen hunting licenses from $1 to $2 each and creating a new license for citizens under eighteen years of age. This license costs $1. At the same time the license year was changed from a fiscal year to a calendar year basis; 1928 was the first year that this law was effective and the sale of licenses that year showed a decrease of 29,042 in number from the year preceeding, which year was the largest in point of revenue and number of licenses sold of the $1 series. The sale in 1929 showed an increase of 12,751 in number of licenses over 1928, and lacking 16,291 of equaling the largest number sold in any year.

HUNTING LICENSE SALES

Year	*Total sales*	*Number of licenses*
1907–08	$118,427 00	113,975
1908–09	114,950 00	111,911
1909–10	128,450 00	124,421
1910–11	143,265 00	138,669
1911–12	146,181 00	141,777
1912–13	165,984 00	159,762
1913–14	164,111 00	159,164
1914–15	166,307 00	161,402
1915–16	159,991 00	155,522
1916–17	170,806 00	166,372
1917–18	177,065 00	No record
1918–19	178,937 00	No record
1919–20	221,433 00	No record
1920–21	240,353 00	225,454
1921–22	236,891 00	222,791
1922–23	239,149 00	226,381
1923–24	260,846 00	246,299
1924–25	245,591 00	226,421
1925–26	252,017 00	231,305
1926–27	279,701 00	253,532
1927–28	285,362 00	257,738
*1928	464,145 00	228,696
*1929	488,114 32	241,447

*Years 1928 and 1929, citizen licenses increased from $1 to $2 each.

ANGLING LICENSES

As previously mentioned in this report, the hunting license law was passed in 1907, but persons were allowed to fish in this state without the requirement of an angling license until 1914, when the angling license law became effective. This license was also in three classes, namely: Citizen-resident licenses for $1, nonresident at $3 and alien at $3. Persons under the age of eighteen years were not required to have a license. This license was on a calendar year basis. During the

period of fourteen years the sale of these licenses more than tripled. The greatest number of licenses sold was in the year 1927, the number being 262,886 for a value of $273,202. These figures do not include persons who were under the age of eighteen years of age who are allowed to fish without the requirement of a license. Incidentally, this was the last year of the $1 license.

On the appended chart, it will be noted that the year following, which was the first year of the $2 citizen licenses, there was a decrease in the number sold of 46,150. This decrease, which occurred also in the hunting licenses, was due more or less to many persons not being in sympathy of increasing the license fee, deciding neither to hunt or fish. Sooner or later this class of people will realize the beneficial results that are being obtained from the money derived from the sale of the same and will eventually buy their licenses.

ANGLING LICENSE SALES

Year	*Total sales*	*Number of licenses*
1914	$ 84,417 00	81,965
1915	89,620 00	87,262
1916	115,518 00	111,994
1917	125,572 00	No record
1918	123,080 00	No record
1919	146,724 00	No record
1920	163,183 00	No record
1921	183,319 00	176,873
1922	189,738 00	183,116
1923	232,995 00	225,171
1924	210,988 00	202,690
1925	232,501 00	222,983
1926	256,629 00	246,167
1927	273,202 00	262,886
*1928	443,660 00	216,736
*1929	469,442 20	229,374

*Years 1928 and 1929, citizen licenses increased from $1 to $2 each.

Civil War Veterans. Both the hunting and angling license acts provide that veterans of the civil war may be issued licenses free of charge. The number of licenses that are issued each year has been steadily falling off as there are not many of the veterans surviving. In 1917, there were 206 hunting and 252 angling licenses issued, while in 1929 there were 34 hunting and 64 angling. These figures are for the entire state.

TRAPPING LICENSES

In 1917 a law was enacted requiring all persons over the age of eighteen years, who trapped for fur-bearing mammals for profit, to have a trapping license. The fee of this license was qiute small, being $1 for citizens and $2 for aliens. An open and closed season was placed on fur-bearing mammals, the open season being during the winter months when the furs were prime and would receive the best prices. Every person who takes out a trapping license is also required, at the end of each year, to file a report to the Division of Fish and Game, listing their catch and the price obtained for the same. By this information the division has been enabled to enact other legislation regulating the taking of fur-bearing mammals.

DEER TAG LICENSES

For a number of years the division had in mind the enactment of legislation by which it would be possible to obtain information as to the

number of deer legally killed each year and also in a material way to curtail the illegal killing of deer, consequently, in 1927, the deer tag license act was passed, which act requires every person who hunts deer to have, in addition to his regular hunting license, a deer tag license, the cost of which is $1. As the law allows each hunter to take two deer each season, the tag was made in duplicate and must be carried by the hunter at all times when hunting deer. Immediately upon killing a deer the hunter must attach one-half of the original tag to the horns of the deer and the other half must be mailed to the office of the Division of Fish and Game, giving information as to the number of horns and the time and place where killed. From the information that has been received from the cards returned by the hunters, it has been shown that the deer population of the state is practically holding its own. Through this source of information it can readily be determined whether the population of deer is increasing or decreasing. A comparative statement of the number of licenses sold and deer killed in the three-year period follows:

Year	Licenses sold	Deer killed	Hunters killing one or more deer	Percentage of hunters who killed deer
1927	110,760	19,507	17,284	6.41%
1928	105,638	21,515	19,136	5.52%
1929	115,472	21,222	18,929	6.04%

COMMERCIAL FISHERMEN'S LICENSES

Since 1912 the revenue derived from the sale of commercial fishermen's licenses, which are also known as market fishermen's licenses, has increased from $23,860 to $60,140 in 1929–30. This license requires that all persons who fish for the purpose of selling their catch must be licensed, the cost of such license being $10 for all persons. The bulk of the sales are made around San Francisco Bay, Monterey, San Diego and San Pedro. A few licenses are also sold along the Sacramento River, Shelter Cove, Humboldt Bay and Requa.

FISH PACKERS' AND WHOLESALE SHELL FISH DEALERS' LICENSES

The law requires that any person or corporation in this state who cans, cures or preserves any fresh fish taken in the waters of this state or brought in from the outside or who manufactures any fish meal, fish oil or fertilizer from fish or who deals in shellfish by wholesale, must take out what is known as the Fish Packers' and Wholesale Shell Fish Dealers' license. The fee for this license is $5 for citizens and $20 for aliens. Since 1912–13, the returns from the sale of this license have made only slight changes, some years showing a slight decrease while in other years a slight increase.

GAME BREEDERS' LICENSES

In 1913 a law was enacted permitting persons to engage in the raising and selling of domesticated game birds and mammals. Before a license is issued to the applicant, however, their property is inspected by a representative of the Division of Fish and Game and a report submitted stating the species of birds or mammals that they intend raising and from whom the same were obtained. The division encourages people to engage in this business. In 1914, there were 14 licenses sold, while in 1929, 329 licenses were sold. Pheasants seem to be the principal birds raised.

FISH BREEDERS' LICENSES

Similar to the game breeders' licenses, persons are permitted by law to engage in the culture and propagating of trout and other game fishes. Their operations are under the strict supervision of the Division of Fish and Game, principally to see that their ponds are constructed as provided by law and that no natural stream is obstructed. Most of the fish breeders' licenses are sold in southern California.

FISH IMPORTERS' LICENSES

Under the provisions of this act, trout and other domesticated fish raised in regularly licensed hatcheries under the laws of any other state, may be imported for sale. This act further provides that fish must be tagged. Prior to 1929 practically no licenses were sold, but in that year there were eleven licenses sold for a total of $55.

KELP LICENSES

During the late world war there was a great demand for potash and other chemicals which were used principally in the manufacture of gun powder. As this supply had previously been obtained from foreign countries it was necessary for this country to resort to other means of obtaining a supply. It had been known that potash could be extracted from kelp, and as there were vast kelp beds off the coast of southern California, many large companies immediately started harvesting the kelp for the purpose of extracting the potash and other chemicals. It was deemed necessary to regulate the operation of these companies, so a license was enacted in 1917. For several years there was a good sale of these licenses, but immediately after the war ended practically all operations ceased, as the cost of operating was quite high and potash could be obtained cheaper from Germany and other countries. Since then, however, several companies have been operating principally for the purpose of experimentation.

HUNTING CLUB AND HUNTING CLUB OPERATORS' LICENSES

During the last few years practically all duck hunting has been confined to clubs, private and commercial. Commercial clubs were springing up everywhere, charging fees of from $5 to $10 per shoot, but many of the clubs were so located that there were few ducks on them, and the hunters were getting very poor shooting. Many complaints came to the offices of the division regarding this, so in 1927 the commercial hunting club license and commercial hunting club operators' license was enacted. Every person operating a commercial gun club must take out a license which is known as the commercial hunting club license, and every person employed on such a club also must be licensed; this license is known as the commercial hunting club operators'. For the season of 1929–30 there were 103 commercial hunting club licenses issued and 159 commercial hunting club operators' licenses issued.

In addition to the revenue received from the sale of the above mentioned licenses, considerable money is received each year from the following: Fines, fish packers' tax, kelp tax, fish tags, game tags, and interest.

FINES

All fines that are imposed in the courts for violations of the fish and game laws must be remitted to the State Treasurer and placed to the credit of the fish and game preservation fund. Since 1907–08 the amount of fines imposed and remitted has increased approximately five and one-half times. For the fiscal year of 1907–08 the amount was $15,565.41, and in the year 1920–21, $30,651.50 was collected, while for the year 1929–30, $84,872.40 was received.

FISH PACKERS' TAX

The law provides that every person operating a cannery or reduction plant must pay a privilege tax of 2½ cents for every 100 pounds canned, cured, preserved or made into fish oil, fertilizer or other by-products. The revenue received from this tax has increased from $24,934.60 in 1917–18 to $202,396.07 for the year 1929–30.

KELP TAX

Every person or corporation operating under a kelp license in the harvesting of kelp must pay a tax, but as there are only a few licenses sold each year this tax amount to very little.

FISH AND GAME TAG SALES

Persons operating either under a fish breeders' or game breeders' license are required to tag all fish or game that are sold for consumption. Also fish imported from other states must be tagged. Separate fish and game tags are provided by the Division of Fish and Game and are sold to the dealers as required; fish tags selling for 1 cent each and game tags for 3 cents each.

INTEREST

For the past six years the Division of Fish and Game has been receiving interest on the moneys held in the banks, principally on the trust accounts. For several years this amounted to approximately $2,000 a year, but since the hunting and angling license fees have been increased the amounts that are held in these accounts have likewise increased, and the interest now received is approximately $5,000 each year.

On July 1, 1929, the revolving fund of the division was increased from $16,000 to $25,000. With the latter amount available it was possible for this office to immediately make reimbursement to all employees of the division for expenses incurred by them during the previous month, the revolving fund being reimbursed after the claims had been audited and passed by the State Controller's office. Also all expense bills, upon which a discount was allowed, were paid out of the revolving fund.

In January, 1930, the Bureau of Fish Culture did considerable construction work in southern California. This work continued for a period of about five months and as the employees there were temporary help, this office arranged with the branch cashier at Los Angeles to pay them immediately without the necessity of waiting until the pay rolls were passed.

In the appendix may be found the statement showing the income of the Division of Fish and Game for the eightieth and eighty-first fiscal years, and the amounts received from each series of licenses and also sales made through the offices of the division or remitted direct to the State Treasurer by the county clerks and justices of the peace.

BUREAU OF PATROL

E. L. Macaulay, Chief

The writer took charge of the Patrol Department January 1, 1929, the acting chief of patrol at that time becoming assistant chief in the San Francisco office. The personnel of the Patrol Department consists at the present time of a chief at San Francisco, two assistant chiefs, one at San Francisco and one at Los Angeles; sixteen captains (one in charge of volunteer deputies with headquarters at San Francisco), 103 deputies and two stenographers.

Fig. 9. A fish and game deputy (W. H. Armstrong) in 1900 in a costume often worn in those days.

The division of the state into patrol districts, each under the charge of a captain of patrol, mentioned in the twenty-ninth biennial report, has been continued with very satisfactory results. A recapitulation of the arrests and convictions and fines imposed will be found in the appendix on page 154.

During the spring of 1929, civil service examinations were held. Fifty of the deputies at that time were not on the civil service eligible

list. Two hundred thirty-nine, including men already employed under temporary authorization, took the preliminary examination, and 122 qualified for the final part of the test. In the final test 72 were successful in attaining a passing mark and were placed on the eligible list. During the six months probationary period fifteen failed to demonstrate sufficient ability to warrant their retention in the service, and were dropped. It is thought that a six-months' probationary period is too short to satisfactorily determine whether or not a new man will make an efficient deputy, and it is suggested that this probationary period be lengthened to one year.

During the biennium seven deputies resigned, two of them doing so rather than to face civil service charges, the others leaving to go into other lines of work. One deputy was discharged as the result of civil service trial; another for absence without leave.

Death has taken a very heavy toll during the past two years, Deputies E. D. Ricketts, Wm. Armstrong and G. O. Laws dying from natural causes and Deputy Allan Curry having been killed in line of duty on April 30, 1930, during the arrest of a commercial fisherman in San Francisco Bay. Former Deputy John Burke of San Mateo County also lost his life during this arrest.

Conventions were held during February or March of both 1929 and 1930, the last day in each case being devoted to a barbecue and a pistol competition on state property near the Yountville Game Farm. It is felt that these meetings are very much worth while as the men have a chance to get together and compare notes regarding various methods of enforcing fish and game laws, etc.

During July, 1929, nine Ford coaches were purchased for the use of deputies in the field. These automobiles are located at the following points: Yuba City, Stonyford, Truckee, Mt. Shasta, Eureka, Rocklin, Fresno, Sebastopol, and Alturas.

One of these vehicles was destroyed by fire and one needed an unusual overhauling, due to poor care on the operator's part, but the balance have rendered satisfactory service on the whole.

In July, 1930, eleven additional Fords and three Chevrolets were purchased, so that at the present time 20 per cent of the patrol force operate state-owned cars. Three Ford closed-cab pick-ups with delivery bodies were purchased for use in both patrol and fish planting work. One is assigned to Owens Valley and the other two in the San Joaquin Valley. The Reo fish planting truck, originally purchased during 1928, and fitted with an air-compressor outfit for aerating fish cans, has now been in service for three years and will shortly have to be replaced. Owens Valley at the present time has roads high up on the western slope, many of them reaching elevations as high as approximately 10,000 feet, necessitating much heavy duty work in low gear to deliver fish to the animal pack trains at the end of the road.

A new tunnel propeller shallow-draft speedboat was purchased for use on the Klamath River. This boat has high speed and can navigate very shallow water, and we believe will prove efficient in the important work of protecting the splendid run of fish in this body of water. An outboard motor boat has been procured for use on the Napa River, and is very helpful in checking the immense number of striped bass fishermen who frequent these waters.

A sixteen-foot speedboat was presented to the division by the volunteer deputies of San Francisco, and is available for bay patrol work when necessary. It is portable enough to be transported by means of a two-wheel pneumatic tire trailer which can be attached to the rear of an automobile and speedily moved wherever passable roads can be found.

The boat *Quinnat,* used in the San Francisco Bay patrol, should be replaced as it is becoming increasingly difficult to keep in good running order, and it is no longer economical to attempt to do so as repairs are are becoming very frequent.

The volunteer deputies have rendered valuable assistance, both in their direct individual assistance, and in cooperating indirectly in many and varied ways with our regular deputies' force. A separate report on their activities will be submitted by the captain in charge of volunteers.

FIG. 10. A uniformed and motorized patrol force is the present day contribution to law enforcement.

REPORT OF VOLUNTEER DEPUTIES

By WALTER R. WELCH, Captain of Patrol, in charge

Under the provisions of section 642 of the Political Code, which section defines the duties of the Fish and Game Commissioners, the Commissioners may from time to time employ such deputies, with or without pay, as they may deem necessary to strictly enforce the laws enacted for the protection and preservation of fish and game.

This section of the Political Code also provides that each deputy appointed by the Fish and Game Commissioners to serve without pay, except employes of the federal government, shall furnish the state with a surety bond in the sum of $2,500 for the faithful performance of his duties, the premium on the bond to be paid by the state out of the fish and game preservation fund.

In order that the Division of Fish and Game may receive the benefit of those who are willing to volunteer their services to the cause of fish, game and wild life protection and for the enforcement of the laws enacted for that purpose, and in order to establish and maintain proper morale within the ranks of the deputies appointed to serve without pay, the commissioners have established a system and set of rules governing their appointment and supervising their activities as volunteer deputies and has attached these deputies to the department of the regular patrol.

As the status and authority of the volunteer deputies for the enforcement of the fish and game laws within the state is the same as that of the regular deputies, the system and set of rules that govern their activities are similar to those that apply to the regular deputies and are as rigorously enforced.

Under the system and set of rules governing the appointment and supervising the activities of volunteer deputies of the Division of Fish and Game as established by the Fish and Game Commissioners, a man must be recommended and his appointment sponsored by a regular organized and bona fide fish and game protective association or club.

The recommendation must be signed by the president and secretary of the association or club recommending and sponsoring the appointment, endorsed by the captain of the regular patrol of the county in which the applicant resides, and be approved by the captain in charge of the volunteer deputies.

The activities of the volunteer deputies of the Division of Fish and Game, except those who are in the employ of the federal government, are under the system and rules established for their control, under the direction and supervision of the captain of patrol in charge of volunteer deputies, and are required to render a report monthly, giving an account of their activities in the field in the discharge of their duties as game wardens; such as the number of hunting and angling licenses and deer tags checked; the number of miles of field, streams, coast line and bay shore patrolled; the number of arrests or assists in arrests made for violations of the fish and game law; the amount of fines

imposed and the fish and game conditions observed by the deputy while in the field.

The establishment by the Division of Fish and Game of a system and rules governing the appointment and supervising the activities of volunteer deputies in California is the first of the kind ever to have been attempted in any state, has been more or less pioneering in nature, and in some respects is incomplete, due to lack of time to work out some of the problems.

Under the provisions of the law and the established system and rules the commissioners have appointed 850 volunteer deputies. The appointments of 550 of these deputies are sponsored by bona fide fish and game protective associations and clubs located in various sections of the state and the appointments of 300 are sponsored by the United States Forest Service.

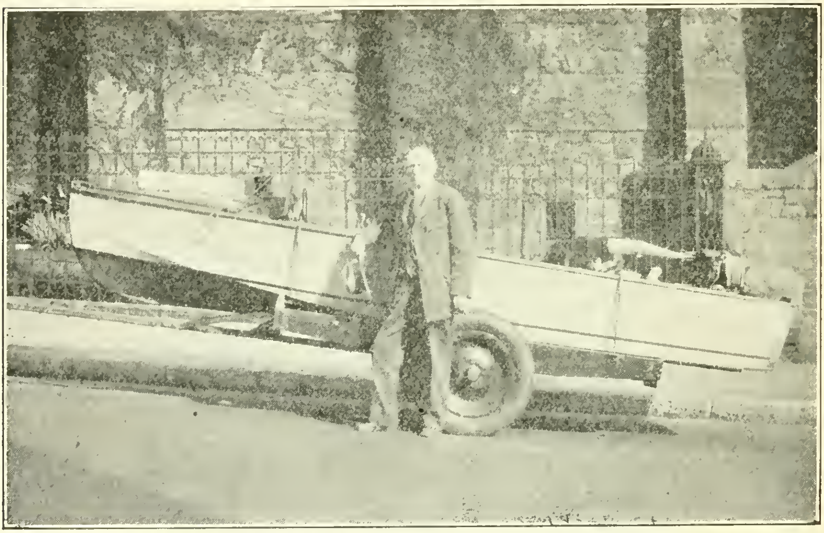


FIG. 11. New patrol boat *Walter Welch* purchased and used by volunteer wardens, on San Francisco Bay. Photo by E. L. Macaulay, April, 1930.

The volunteer deputies of the Division of Fish and Game in 28 counties within the state have been organized and instructed in the discharge of their duties as game wardens, and are now working under the direction of captains and in cooperation and coordination with the deputies of the regular patrol and are performing an exceedingly beneficial and satisfactory service.

A brief and incomplete summary of the reported activities of the volunteer deputies during the past two years indicates that these deputies have patrolled 1,038,038 miles of fields, streams, coast line and bay shores; that they checked 41,570 hunting licenses; 38,863 angling licenses and 8761 deer tags. That they arrested and assisted in arresting 586 violators of fish and game laws in which cases fines in the amount of $20,947 were imposed.

On April 27, 1929, and on April 26 and 27, 1930, state-wide conventions of the volunteer deputies of the Division of Fish and Game were held at San Francisco.

These conventions proved to be a great success and were attended by a large number of volunteer deputies representing nearly every county within the state, who, at their own expense and without cost to the state, attended the convention.

During the past year the volunteer deputies throughout the state in an endeavor to cooperate with the Fish and Game Commissioners in their efforts to reestablish a supply of valley and mountain quail within the state have been active in urging farmers and landowners to voluntarily set aside part of their land as an inviolate quail sanctuary upon which the shooting of quail will be prohibited for a period of three years.

This move on the part of the volunteer deputies has been met by the spontaneous and almost unanimous support of the farmers and landowners, with the result that upwards of five hundred such quail sanctuaries located in various sections of the state have been established.

In order to further cooperate and assist in the efforts being made by the commissioners to reestablish the supply of quail the volunteer deputies will conduct, under the direction of the commissioners, a campaign of predatory bird and animal control on lands that have been set aside as quail sanctuaries.

The appointment and organization by the Fish and Game Commission of fishermen, hunters and out-door lovers who are willing to contribute their services as deputies of the Division of Fish and Game to the restoration of sports afield and astream with gun and rod in California, without commercial, political, or personal ties or hope of reward, is undoubtedly the most comprehensive move and program ever undertaken for the protection and conservation of wild life in the United States.

This movement represents a patriotic and unselfish endeavor to save for our children and for future generations that priceless heritage of nature—the fish, game and wild life of the state, in order that they may enjoy the health, recreation and happiness that only the great out-of-doors can give them.

The volunteer deputies of the Division of Fish and Game of California have been drafted from and represent the highest rank of citizenship within the state—many of them being not only locally, but nationally known—which insures the integrity and high standing of the organization.

Although less than four years have passed since the Fish and Game Commission of California established a system for the appointment and supervision of men who are willing to volunteer their services without compensation as deputies of the Division of Fish and Game for the protection and conservation of fish, game and wild life, and the enforcement of the laws enacted for that purpose, the services that have been rendered by these deputies have been exceedingly satisfactory and have resulted in awakening thousands of sportsmen and people who are lovers of the great out-of-doors to a realization of the perils that are threatening the supply of fish, game and wild life of the state and the

necessity of cooperative action on the part of the sportsmen and the people in general in the work being carried on for the protection and conservation of fish, game and wild life and the strict enforcement of the fish and game laws, as well as the efforts being made for the restocking of the game fields and public waters by the Division of Fish and Game.

The action of men who have, without compensation or hope of reward of any kind, volunteered their services to the Division of Fish and Game, and entered the fields for the protection and preservation of fish, game and wild life and the strict enforcement of the laws that have been enacted for that purpose, is certainly worthy of the highest commendation and surely deserves the hearty and united support and cooperation of all sportsmen and law abiding citizens within the state.

While it is pleasing to be able to report the success of the volunteer deputies, and the system and rules supervising and governing their activities, it is very apparent that in order that the funds expended to maintain these deputies may result beneficially to the cause of fish, game and wild life protection, and that the volunteer deputies continue to merit and receive the confidence, respect and support of the sportsmen and people, is absolutely dependent upon continued and constant personal supervision and the never ceasing stimulus afforded by directed effort that will tend to prevent the lessening of interest in the protection of fish, game and wild life and the strict enforcement of the laws enacted for that purpose.

It is believed that the present bond required of volunteer deputies, viz, $2,500, is unnecessarily high, and that a bond in the sum of $500 would be ample.

REPORT OF THE BUREAU OF FISH RESCUE AND RECLAMATION

By George Neale, in charge

The Bureau of Fish Rescue was created August 1, 1928. The purpose of the bureau is indicated in the title, the rescue and reclamation of fish from areas where they have become stranded by reason of streams and lakes overflowing their banks, irrigation ditches, canals and like bodies of water that become dry and where many millions of valuable food and game fish formerly perished.

Fig. 12. Too late. About 200,000 crappie, bluegill and black bass. Photo courtesy Frederick Burkett.

PROPER SELECTION OF SPECIES

The bureau is an adjunct of the Division of Fish and Game, Department of Natural Resources—very closely allied to the Bureau of Fish Culture and Distribution—necessarily so, for the reason that the promiscuous introduction of certain species, some of which are highly predatory, into waters entirely unsuited to them and which can not but have a harmful effect upon the inhabitants of those waters and which we know from experience can never be corrected. Unfortunately, several species of fish have been planted in waters by enthusiastic anglers whose knowledge of biology is that all a fish needs is just water. As far as is possible no fish are placed in waters until it is determined what species are most adaptable to those waters.

NATURAL PROPAGATION

A very large percentage of the rescued fish are of the spiny rayed tribe of fresh water game and food fishes, black and striped bass, crappies, calico bass, sunfish and several kinds of perch, catfish, etc., none of which can be or are propagated artificially as are trout and salmon. Consequently, in order to maintain the growing demand made upon them by the angling fraternity, all replacements for overfished and barren waters must be made by rescue methods. None of the above named fishes are native to California. They were introduced from the eastern and middle western states and have taken a firm hold in their adopted state. It is the habit, when possible, for these species, with the exception of the striped bass, to leave the parent stream at the spawning period and enter the shallow sloughs, canals, ditches, lakes and pastures, where the spawning takes place. This usually occurs during the period of high water. When the waters recede they, with their young, become prey to the numerous predatory birds and animals, if not removed.

FUTURE SUPPLY ASSURED

The rescue bureau goes a step further than just netting and rescuing fish and returning them to the waters from whence they came. Every advantage is taken to maintain a permanent supply and to distribute them to other adaptable waters, all over the state. In the seining operations the parent fish, which are generally found with their young, are returned to the main bodies of water with about 50 per cent of the young fry. The surplus are used to fill the many applications for them which are made to the fish cultural department. In this way a future supply is maintained and assured.

These natural outdoor hatcheries are so situated by nature that they could not be duplicated by artificial effort except at an immense cost. The propagating areas are formed generally in the lowest lands at the confluence of two streams, such as the Sacramento and American rivers or the Mokelumne and Cosumnes. These four streams alone, with their tributaries, furnish 80 per cent of all the spiny rayed fish rescued and distributed to all parts of the state. An estimate of the area of these outdoor natural hatcheries in a normal winter of rainfall is about seventy thousand acres of surface water, composed of small ponds and lakes and overflowed areas, of from one to four hundred acres each. Nearly all of this area is connected at flood water with some important river or lake, where these fish abound.

The most essential elements in all waters containing fish are food, spawning grounds and an abundance of subaqueous plant life, which furnishes both food and shelter for the young fish, and without which there can be little or no natural propagation. These natural hatcheries contain all these elements, their propagation costs nothing, they require no feeding as do artificially hatched fish, no buildings or attendants. These is no element of disease, no watchful eye of the fish culturist—nature does it all without cost, but when nature has completed her wonderful work, then conservation begins. The young and adult fish must be removed to permanent waters, overfished waters must be stocked, barren waters must be supplied to furnish sport and food.

IMPORTANCE IN OTHER STATES

The states of Illinois, Iowa, Indiana, Kansas, Minnesota, Nebraska, Wisconsin, South Dakota, Louisiana, Missouri, Michigan, Connecticut, Ohio, Oklahoma, and a number of other states not so favored by trout waters as is California, derive a large portion of their license revenue from these spiny rayed fresh water game fishes. They specialize entirely upon the propagation of this tribe of fishes at a cost of from $25 to $40 per thousand.

With the single exception of the yellow perch, the spiny rayed fishes can not be propagated artificially as are trout and salmon. They can not be stripped of their eggs as are trout, hence the necessity of these states creating seminatural or artificial outdoor propagating ponds in order to maintain the demand by the anglers of these states. Many of these states expend a large amount of their income in the propagation

Fig. 13. Pot hole in irrigation ditch near Tracy from which striped bass were rescued for transplanting in the Salton Sea. Photo by E. S. Cheney, October, 1929.

of these fish. Arkansas claims to maintain the largest acreage of propagating ponds in America—a series of ponds just completed, at a cost of $175,000. The state of Illinois operates eleven seminatural ponds for spinous fish. They also operate four rescue stations with crews. This would indicate the value of these game fishes to these states.

Such expenditures will not be necessary in this state as long as the fish are rescued from the immense natural propagating areas in the Sacramento and San Joaquin valleys. The growing demand for both large- and small-mouth black bass can be met by setting aside certain natural ponds or lakes which may be acquired by rental and maintained as bass propagating waters. There are many such ponds and reser-

voirs in the lower altitudes, in fact the chiefs of the Bureau of Fish Culture and Fish Rescue are now working on such a project.

Total Number of Fish Rescued from August 1, 1928, to June 30, 1929, by Species

Green sunfish	374,705		
Bluegill sunfish	65,407		
Crappie	29,231		
Striped bass	122,408		
Catfish	154,117		
Black bass	218,419		
Rainbow trout	3,435		
Salmon	350		
Yellow perch	1		
Sacramento perch	100		
		968,173	
Hanford rescue crew, all species		157,905	
Newman rescue crew, all species		155,626	
			1,281,704

Total Number of Fish Rescued from July 1, 1929, to June 30, 1930

Green sunfish	2,249,623		
Bluegill sunfish	367,071		
Crappie, calico bass	927,453		
Catfish	252,765		
Striped bass	10,004		
Black bass	1,700,088		
Rainbow trout	40,140		
Salmon	156		
Sacramento perch	8		
		5,547,308	
Aided by volunteers of Sacramento County		141,313	
			5,688,621
Grand total rescued to June 30, 1930			6,970,325

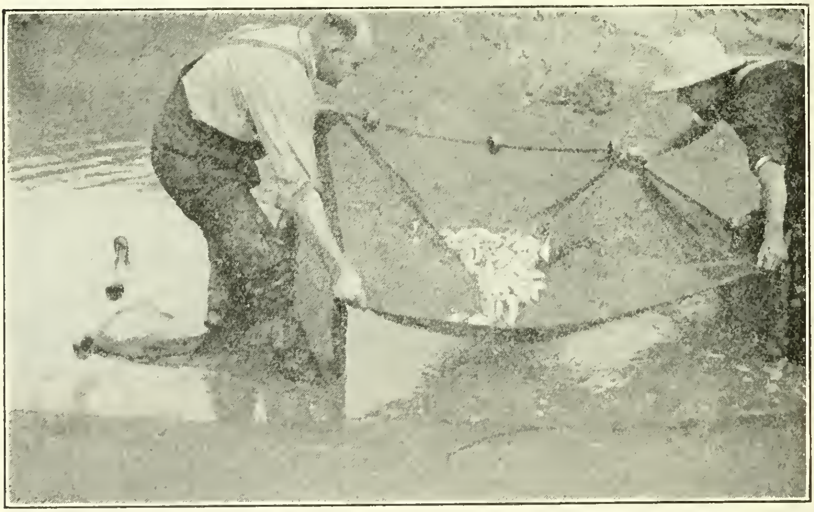


FIG. 14. Seining striped bass near Tracy, California, December, 1929, for experimental planting in Salton Sea. This is typical of the work of the Bureau of Fish Rescue and Reclamation. Photo by George Neale.

Approximately 75 per cent of the rescued fish are what we have classed as number "ones," two inches or less in length. Twenty-two per cent are yearlings, and 3 per cent are adults of all sizes. We have devised a system by which we are able to count small fish by small dip net measurement, which is approximately 98 per cent correct. All figures are very conservative.

One of the outstanding accomplishments of the Bureau of Fish Culture and Rescue is the successful transportation and planting of two carloads of striped bass—five thousand fish of from four to six inches in length—to the Salton sea in Riverside and Imperial counties. This body of water is of a saline nature and is forty-five miles in length and fifteen in width. It is one of the most important experiments in fish introduction into water of like character anywhere.

The following distribution of rescued fish to barren waters has been made possible by the fine cooperation given by the Bureau of Fish Culture and the Bureau of Patrol:

Season of 1928, August 7th to December

Diez Lake, Inyo County	Crappie, catfish, sunfish	1,200
Big Bear Lake, San Bernardino County	Catfish, sunfish	300
Ponds at Atherton, San Mateo County	Black bass	12
Steinhart Aquarium, San Francisco	Black bass	24
Feather Hill Ranch, Santa Barbara County	Catfish, crappie	650
Altadena ponds, Los Angeles County	Sunfish	50
St. Mary's College, Contra Costa County	Sunfish, crappie	300
Searsville Lake, Santa Clara County	Bluegill, sunfish, crappie	100
Laguna Lake, Orange County	Catfish	150
Fairmont Lake and Evans Lake, Riverside County	Sunfish, crappie, bluegill, black bass	1,515
Eagle Lake, Lassen County	Crappie, black bass, sunfish	1,322
Guadalupe Lake, Santa Barbara County	Catfish	300
Santa Anita Dam, Los Angeles County	Catfish, sunfish	?
Foss Lake, San Diego County	Catfish, sunfish, crappie	540
Henshaw Lake, San Diego County	Sunfish, catfish, crappie	695
Hughes Lake, San Diego County	Catfish	1,000
Riverside Lake, Riverside County	Black bass, crappie, sunfish	1,605
Corners Station, Kern County	Black bass, crappie, sunfish	664
Bakersfield Athletic Club, Kern County	Sunfish, black bass, crappie	700
Stanislaus River	Black bass, crappie, sunfish	1,822
Kings River, Kings County	Catfish	15,000
Cross Creek, Kern County	Catfish	40,000
Kaweah River, Tulare County	Catfish	40,000
Kern River, Kern County	Rainbow trout	137

Season of 1929

Lake at Redding, Shasta County	Sunfish, crappie	2 cans
Lake at Watsonville	Black bass	4 cans
Los Gatos	Black bass, crappie, sunfish	3 cans
Los Angeles	Black bass	8 cans
Vallejo	Black bass, crappie, sunfish	12 cans
San Diego	Black bass	126 cans
Susanville	Crappie	126 cans
Lincoln, Placer County	Black bass	2 cans
Redwood City	Catfish, crappie	2 cans
Lone Pine Chamber of Commerce	Catfish, crappie	1,000 fish
Dan Payne, Ashland, Oregon	Catfish	60 fish
Oregon Chamber of Commerce, Portland	Catfish	?
Golden Trout Club, Lone Pine	Crappie	36 cans
Yuba Fish and Game Association	Black bass, crappie	30 fish
El Centro Chamber of Commerce	Striped bass	126 cans
El Centro Chamber of Commerce	Striped bass	140 cans
Turlock Reservoir	Catfish	60,000 fish

A can carries from four to eight large adult fish, according to the size of the can and the fish. A can's quota of small fish is from forty to one hundred.

The rescue and distribution of the game and food fishes is one of, if not the most forward conservation measures accomplished by the Department of Natural Resources. The value of the food supply, the pleasure afforded to men, women and children in their pursuit, can not be estimated in dollars. All of the spinous fishes are the equal, if not more delicious as a pan fish than trout. They are available to those who are unable to go to the mountain streams for trout.

In addition to rescue work an analysis is being made of the stomach contents of the spiny rayed fishes in an effort to learn which of the species are more predatory. Also particular attention is given to the

range of the spawning season. This will enable us to determine the right season to take them. A record of overflowed lands, fed from waters that contain edible fish, is kept. Also a record of all fish from each body of water, where and when taken, their disposition, and the name of the owner or lessee of such lands.

In addition to the rescue work, 1556 small-mouth black bass fry and eight adult bass were secured from the Salt Spring Reservoir, Calaveras County, and planted in the Citrus Grove pond near Oroville, as a propagating pond for that species of bass.

The one rescue of most importance to the sportsman angler was the rescue from Concow Creek, Butte County, below the dam, of 500 adult rainbow trout of four pounds each, 100 of three pounds, 1400 of two pounds and 435 yearlings, making a total of 2435 trout, weighing approximately 5208 pounds. This was accomplished with the assist-

FIG. 15. Rescue work below the Soncow Dam. Some of the 4½ tons of rainbow trout. February 27-March 2, 1929.

ance of the local deputy, A. J. Stanley, fourteen volunteers from Oroville and Chico, and the rescue force from Sacramento. The bureau was aided by several market fishermen, who gave valuable assistance by the use of their large nets, boats and crews and in return were permitted to keep the rough fish, pike and hardheads, as there is very little or no demand for them except by the Chinese. These men, together with volunteer sportsmen, were the means of saving 141,313 game fishes, nearly all of which were adults or breeders.

I trust that it is in order to thank all those farmers who allowed us the freedom of their lands, and those who notified us of the necessity of saving many fish. Also, thanks are due the head of the Bureau of Fish Culture for making it possible for such wide distribution and prompt delivery by our distributing car and the skillful handling of the fish. Also to the many deputies who have given fine cooperation, both in assistance and by correspondence.

REPORT OF THE BUREAU OF FISH CULTURE

By W. H. SHEBLEY, in charge

In compliance with the regulations and for the information of the Division of Fish and Game of the Department of Natural Resources, the Bureau of Fish Culture herewith submits a report on the operations of the hatcheries, distribution cars, egg-collecting stations, biological work, feeding experiments, and recommendations to improve the conditions of the trout and salmon distribution works, as well as other activities of the bureau.

During the biennium from July 1, 1928, to July 1, 1930, the largest number of trout has been planted in the history of the Commission—62,000,000—as well as 10,500,000 salmon. Owing to the long drought that has lasted for a period of approximately sixteen years, the best results could not be obtained in all districts. We have on hand for the 1930 distribution 35,000,000 trout.

The dry cycle or period of prolonged seasons of light snow falls and light rains has caused a marked decrease in volume of many streams and the lowering of the water table in the great central valleys of California. Higher temperature of the water has been caused by the lessening flow each season for a period of sixteen years and by the storage of water for power and irrigation. This condition has been a source of anxiety to the employees of the Bureau of Fish Culture as it has caused a complete physical change to take place in the amount of water in many creeks as well as in the plankton and habits of the fish. This we have tried to meet in a practical and scientific way. We have maintained good fishing in the majority of the lakes and streams, when all conditions are considered.

We feel that the Division of Fish and Game has accomplished remarkable results in the number of fish distributed. The different species of trout have been allocated to the waters to which they are best suited, when the amount of water, temperature, and all the changes brought about by irrigation systems, power dams, deforestation, shortage of water, excessive fishing, etc., are considered. We have operated twenty-eight hatcheries and fifteen egg-collecting stations. The output of the hatcheries, amounting to 62,000,000 trout of the different species, have been distributed with the assistance of the deputies, anglers, and persons interested in the planting of trout for recreation and business purposes. We have been ably assisted by members of fish planting clubs and other organizations, as well as by the railroads who have issued us free transportation for our distributing cars and crews engaged in fish planting work. At many of the hatcheries trucks have been used in making the distribution and, in the regions away from the roads, pack trains have been extensively used in the distribution work. With considerable gratification we have found that where the conditions of the water were favorable the fish have actually increased despite the heavy fishing. This is notable in Lake Almanor, June Lake, Butte Lake, and the Klamath River, as well as in several other locali-

ties. The run of trout in the upper reaches of the Klamath was larger last fall during the salmon run than it has been at any time during the last ten years. The trout ascended the river in larger numbers than usual, evidently not being affected by the condition of the river.

Last fall at our salmon racks at Klamathon, we removed from our traps and put upstream above the racks from 150 to 300 Rainbow trout per day for sixty days or longer. These were all large fish and there was a horde of smaller trout that went through the rack gratings. In spite of this, the largest run of trout in the Klamath in ten years, the take of eggs was small during the spring of 1930 at all the collecting stations, due to the lack of high water, continual cold water in the tributaries, and the warmer water of the Klamath River that caused the trout to remain in the river and not ascend to the traps in the tributaries. This condition is not unusual. The fishing in the river up to June 30th has been below par due to many causes, but not to a dearth of trout.

STREAM CLOSING

The closing of streams by the Director of Natural Resources, as recommended by the Division of Fish and Game, has given good results. This work should be continued and where necessary should be repeated until the streams are fully restored. While we have planted 62,000,000 trout during the biennium just passed, and have for the 1930 distribution 35,000,000 fish to be planted in waters throughout the state, we again repeat that a larger number of fish should be planted as the ever-increasing population of the state demands, if we are to maintain the present fishing average in our lakes and streams. There are waters suitable for every species of trout in California. Some of our larger rivers and streams in the lower altitudes will not support the native species as they did before the changes brought about by our advancing and ever-increasing population, but exotic species that have become resistant to higher temperatures, bacterial infestations, and a changed natural food supply, will thrive and furnish food and sport in places where our native trout will no longer thrive in numbers great enough to justify the efforts to keep the lower reaches of our larger streams stocked.

On the arrival of the pioneers, before the beds of streams and large pools were filled with gravel from the thousands of placer, hydraulic, and quartz mines, and before the forests were removed from the banks of the rivers and soil washed into the streams by erosion caused by the rains on cultivated lands, the Rainbow trout descended to the lower reaches of the larger streams. Before the mines were worked out or hydraulic mining stopped, and the forests removed for the lumber or cleared away for farming purposes, the physical conditions of practically all the larger streams and rivers that had their source in the Sierra were so changed that the Rainbow could not exist in the lower reaches of these streams. Brown trout and Loch Leven are taking their places, as they are more resistant to the conditions now prevailing in these streams. The erection of high dams and the holding back of the water for irrigation and power, also has a tendency to cause the water to get much warmer during the summer months. The dry period or cycle which has prevailed for approximately sixteen years has had a marked effect on the condition of the water in our streams.

The conditions mentioned above are only a few of the many changes that are prevailing on the terrain through which our beautiful mountain streams once flowed. At the upper reaches conditions are still good and our native fishes will continue to thrive in the lakes of the high Sierra, as well as in hundreds of tributary streams and in all of the headwaters of our rivers.

We have operated 28 hatcheries and 15 egg-collecting stations during the last two years. The total trout distributed of all sizes, from $1\frac{1}{2}$ to 4-inch fingerlings, was over 62,000,000. We collected from the Klamath River 8,219,000 salmon eggs, which were hatched and the resulting fish planted in the Klamath River. The last two seasons were unfavorable for the collection of salmon eggs owing to the dry open fall weather, which was warmer than usual at the period when the salmon were ascending the river, which always causes a light run of salmon in the upper reaches of the river. This condition has been observed for the last twenty years, as tables of egg-collecting operations at Klamathon will show. We have added to this report the tables of salmon egg collections for the last ten years to verify this statement.

SPINY RAYED FISHES

We again repeat our recommendation that ponds should be established for the rearing of spiny rayed fishes. The Bureau of Fish Rescue and Reclamation, organized during the last two years, has done some very valuable work in rescuing thousands of valuable food and game fishes that would have perished when the receding waters in the overflow basins and residual pools were drying up. These last two seasons were the worst, probably, in the state's history, and the organization of the bureau has been of inestimable value in rescuing the fish that otherwise would have been prey to the fish-eating birds or perished when the water dried up.

BROOD PONDS FOR SPINY RAYED FISHES

In addition to this valuable work, ponds, such as we recommended in 1918, and for lack of funds were not built, should be established to add to the number of spiny rayed fishes to be planted each season. As soon as funds are available, properly built ponds should be established where the different species can be propagated with a minimum of cost after the construction of the ponds, etc.

We have trained fish-culturists who can successfully raise these fish for a small sum and thus add to the food and game fish supply of the state. This work, in conjunction with the rescue and reclamation operations, will be of vast benefit to the state.

PONDS FOR TROUT

I wish again to recommend the building of ponds for the rearing of trout for brood stock. We can close certain lakes for this purpose and get a great deal of benefit from such lakes, but fish in natural lakes, no matter how well stocked, are subject to seasonal weather conditions that do not prevail in artificial ponds where the brood stock is always under control of the fish-culturist. These programs require money, and if the people desire to enjoy fishing for pleasure and food a larger license will have to be paid to provide the funds for the necessary

expense. One or two limits of fish will pay for the license from a food value standpoint, not counting the benefit to be derived from recreation for the one or two days' fishing, with a whole long season to fish in if one so desired.

FISH EGGS AS BAIT

Our efforts to prevent the use of salmon eggs for fish bait failed of passage by the legislature. As long as the use of fish eggs is allowed in this state, so long will the small, immature fish be taken. There are many kinds of natural bait that can be used by those who do not care to use a fly or spoon, and are not in favor of chumming the fish or causing them to gather in large schools where all sizes are taken regardless of the results. So long as those who use salmon or other fish eggs can satisfy their desire to catch fish with little effort or skill, and to the everlasting detriment of the game fishes in any water where they

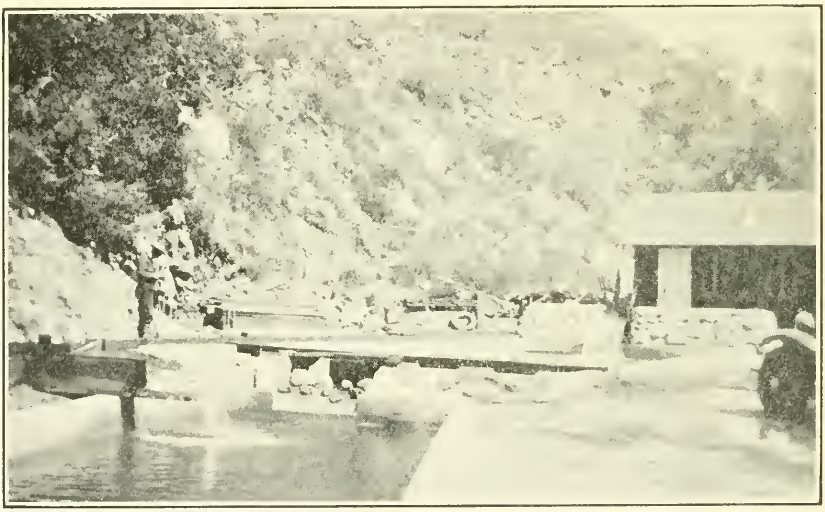


FIG. 16. Pond system Rincon Station, North Fork San Gabriel River, Los Angeles County. Photo by D. A. Clanton, March, 1930.

are used, hundred of thousands of small fish will be taken long before they are large enough to catch. We should use our best efforts to stop this kind of fishing.

Following is a brief summary of our reports on the operations of the different hatcheries:

MT. SHASTA HATCHERY

The Mt. Shasta Hatchery, established in 1888 as a salmon propagating station, has grown in importance through the passing years until today it is one of the largest and best equipped hatchery stations in the United States. This station was rehabilitated during 1927 and placed in excellent condition. There are five hatchery buildings at this station, and 54 ponds for the rearing of brood fish stock. The output of eggs from these ponds is one of the best investments in fish cultural work in the state. The supply of eggs can always be depended

upon regardless of weather or other conditions. The work of this station during the biennium from June 30, 1928, to July 1, 1930, consisted principally of fish cultural operations as the improvements and repairs made during 1927 put the station in first class order. During the next biennium the following improvements are necessary: new understructure to Hatchery "A," new pipe lines, new fencing, a new well, repairs to the power line and to the ice plant, totaling about $3,350.

During the years of 1928 and 1929, the general work and the output of the station was fully up to the average. Several experiments in feeding other foods than those usually fed at this hatchery were made during the year, but the results are chiefly valuable in determining what not to feed rather than what to feed. Reports of the experiments have been made by Dr. Coleman and published by the division.

Several improvements were made at the Mt. Shasta Hatchery. One was the putting in of a small concrete dam in Spring Creek and running a pipe line of 16-inch pipe 975 feet to the diversion tank in the hatchery grounds. This was a major improvement inasmuch as it did away with the old flume and ditch, and in a great measure did away with the moss and drift that worked into the ditch. The pipe was buried underground and is out of the way and permanent. Another improvement was the building of a new water tank to handle the water from the pump for all domestic purposes within the hatchery grounds, and for irrigating the gardens. The new tank is on a tower 36 feet high with a base of concrete 18 by 18 feet. The tank holds 4000 gallons of water. The structure is covered with rustic and is attractive and well built. Up to June 30, 1930, all the buildings have been painted except the can house, lumber shed and several wood sheds. This puts them in good repair. Also a new pipe line was laid from the water tank to the residence and the residence refitted with new plumbing.

CAMP CREEK EGG-COLLECTING STATION

At the Camp Creek station a new cabin was built for use of the man in charge during the spawn taking season. It is a plain, two-room affair, but is warm and comfortable. This is the only improvement at this station. Eggs collected during the biennium totaled 1,673,000.

FALL CREEK HATCHERY

At the Fall Creek Hatchery the results were good. During 1929, 4,005,000 Quinnat salmon eggs were received, 402,000 were lost and 3,603,000 planted. Rainbow trout eggs were received to the number of 603,000; 23,000 eggs and fish were lost and 580,000 planted in the tributaries of the Klamath River. This was almost 90 per cent efficient for the salmon and a little over 96 per cent efficient for the trout. Of course, the greater number of the trout eggs were received after they were eyed and after all loss in hatching had been deducted.

In addition to the trout and salmon planted in the tributaries of the Klamath River from the Fall Creek Hatchery, there was a total of 439,000 Rainbow trout planted in tributaries of the Klamath River and Scott River, the latter stream being also a tributary of the Klamath. These fish were planted by the different associations of Yreka, Scott Valley, and by the force of the Klamath National Forest.

Alterations and repairs at the Fall Creek Hatchery, which are immediately necessary, total about $550.

Total fish planted during seasons of 1928 and 1929: trout 1,176,000; salmon 6,854,000. Number of fish and eggs on hand for distribution during the season of 1930: trout 1,078,000; salmon 2,939,000.

SHOVEL CREEK

During the year 1929, an egg-collecting station was established on Shovel Creek. Years ago this creek was noted for the heavy run of trout it carried, but since the building of the Copco Dam the runs have fallen far short of the old time average. The station was built in order to take eggs from the native Rainbow that were nonmigratory. While the take was small, we are looking for a larger take at the station in 1930. There should be a cottage built for use of the crew operating the station.

SHACKLEFORD CREEK

There should be a new cottage at this station, which may be built at a cost of approximately $600, and a new well should also be driven.

HORNBROOK EGG-COLLECTING STATION

Repairs were made on concrete wall and traps. The low water in the creek during the last two springs caused a much less number of eggs to be taken than was expected. Owing to the drought for several seasons past the irrigationists turn the water into their ditches, thus reducing the flow in Cottonwood Creek, so that early in April no fish can ascend the stream. This is one of the late spawning streams and during seasons of normal rainfall furnishes a large number of eggs after April 1st. The total eggs collected during the last two seasons averages 2,343,000.

BEAVER CREEK STATION

This station was operated successfully during the last two seasons, but owing to the severe seasonal conditions an egg take was not up to our expectancy, as under the lease we must open the dam and allow the fish to ascend the creek on May 1st. If the station could have been operated after May 1st, more eggs could have been collected. Total eggs collected during the last two seasons, 2,222,000.

BOGUS CREEK EGG-COLLECTING STATION

The run of fish at this station has been all that could be expected during the seasons of 1929 and 1930, as the weather conditions prevailing throughout the Klamath region were not favorable during the last two seasons for the trout to ascend the tributary streams. The streams were low and cold and the trout did not ascend in as great numbers as usual, although there were large numbers in the river. Total eggs collected during last two seasons, 2,479,000.

YUBA RIVER HATCHERY

This experimental station was established during 1928. The water so far has proved suitable for hatchery purposes. The most important improvements and repairs at the Yuba River Hatchery have been the

completion of the hatchery building that was first installed under a tent, putting in windows and placing new roof on same, repairing flume and settling tank. A loading platform and signs posted along the hatchery water supply would improve conditions at this station. The roof is of a cheap grade of paper and will be replaced as soon as funds are available with corrugated iron.

Number of fish hatched and distributed from this station during last two seasons, 449,735.

The site for this hatchery is situated on Fiddle Creek, a tributary of the North Fork of the Yuba River, about 34 miles north of Nevada City. The site was obtained by a lease from the Pacific Gas and Electric Company and from Mrs. A. F. Craig. If this site proves suitable for hatchery purposes, it will be a great benefit in the distribution work as it is centrally located in the Yuba River system, besides a number of lakes can be easily reached from this station. The water so far has been pure and no infection due to the water has affected the eggs or fish.

BURNEY CREEK HATCHERY

Following is a report of the major improvements accomplished at this hatchery during the last two seasons. A rock wall was built under the hatchery as an improvement to prevent the cold winds from blowing up through the floor during the winter months and a lot of work on the road to insure against accidents where the road was too narrow on turns and quite dangerous, and where some accidents had already occurred. A ladies' rest room was built, and an aquarium in the hatchery.

Other improvements are necessary at the Burney Creek Hatchery. A small freezing plant should be installed and there should be $500 allowed for constructing an additional cottage or cabin.

The total output of fish from this station during the last two seasons was 2,884,000.

An experimental egg-collecting station on Toms Creek, a tributary to Ballard's Reservoir, was opened. The egg take was small and most of the males were in poor condition, making the percentage of fertilization very low, and unless the reservoir can be closed to fishing at all times so it can be built up with fish, it will not pay to operate there.

BUTTE LAKE

The fish there are good spawners. This lake ought to produce not less than 2,000,000 eggs and should be operated as an auxiliary station to the Burney Creek Hatchery. Due to the heavy fishing by the tourists at present, the lake will have to be closed until later in the season, and would suggest closing it until the first of July or all the year if possible. The main reason for having a later opening season is due to the fact that in the month of May, when most of the fish are caught, is when the fish are looking for an outlet to the lake and there being no surface inlet or outlet to the lake, the fish mill around the lake on the shore line where the water is so shallow that their backs are out of the water and at that time anyone can catch all the fish they care to. Later on, after the spawning is over, the fish quiet down and return to the deeper parts of the lake where the anglers can not slaughter them as

they do when they are trying to spawn. We recommend that the Park Service be requested to close Butte Lake as a fish preserve.

KLAMATHON SALMON EGG-COLLECTING STATION

This station was established in 1910 for the purpose of collecting salmon eggs for distribution in the Klamath and Sacramento rivers. The station is subject to seasonal conditions probably more than any other station on the coast. During a season of early rainfall and falling temperatures, the salmon ascend the river in large numbers; during seasons of warm and dry weather in the fall the salmon run in the upper reaches of the Klamath River is light. As far as our observations are concerned and knowing that the run of salmon is not constant, but in the upper reaches of the river is governed by seasonal conditions, we are not prepared to state whether the run of fish has been reduced by excessive fishing in the ocean areas before entering the river or not.

A comprehensive survey of the river covering a period of years will, in our judgment, be necessary before determining whether the run has materially decreased or not. The movements in the upper reaches of the river fluctuated in the same manner some twenty years ago as it has during the last ten years.

Following is a table of the number of eggs collected from the Chinook salmon, which clearly indicates the fluctuating numbers of salmon in the runs as they reach the traps at the Klamathon Station:

Collection of Quinnat Salmon Eggs from Klamath River from 1920 to 1930, Inclusive

Klamathon Station

Year	*Eggs*
1919	4,974,000
1920	7,110,000
1921	19,178,000
1922	20,824,000
1923	5,762,000
1924	6,735.000
1925	18,042,000
1926	11,797,000
1927	4,621,000
1928	5,016,000
1929	3,103,000
Total	107,162,000

All the salmon eggs collected during the last three years have been hatched at Fall Creek station and the resulting fingerlings have been returned to the river. Our opinion, based on over thirty years' study of the fishing conditions in the Klamath River, is that when seasonal conditions change and a period of normal rain and snowfall prevails, the salmon will reach the Klamathon Station in numbers that will average the same as they have for the last twenty years. The water is held back in the Klamath Lake by the power company during the dry season and has its effect on the salmon run as is definitely proven by the movements of the salmon.

The Klamath, like all rivers in this state, is heavily fished, but the number of salmon taken, except in the cannery, has no effect on the run on the upper reaches of the river. The cannery, in our judgment, takes only a small percentage of the run as the ocean fishing no doubt is of greater consequence than the operation of the cannery on the salmon that ascend the river.

PIT RIVER EGG-COLLECTING STATION

The construction of an egg-collecting station at Hagen Flat on Pit River by the Pacific Gas and Electric Company in lieu of a fishway over their high dams in the Pit River has been decided on and a site has been selected, survey made, and all preparations are now under way to install this station during the coming summer and fall. We waited several years before making a request of the power company to build this station, as it was not certain whether enough salmon would ascend the Pit River to justify the expense of establishing a salmon egg-collecting station. After a number of surveys on Pit River during the salmon spawning season, we discovered that a sufficient number of salmon ascended the stream to justify us in our request that the company construct racks, traps, and an egg-collecting station on a site selected below Power House No. 4 of the Pacific Gas and Electric Company. This station, do doubt, will enable us to collect a number of trout eggs each spring for the Burney Creek Hatchery. We hope to see this station installed and ready for the trout run this coming spring and in readiness for the salmon run in the fall of 1931.

FORT SEWARD HATCHERY

The following list covers the more important work and improvements at this station during the past biennium, details following the list:

- Installation of domestic water system.
- Road work.
- Raising and leveling of assistant's cabin.
- Wood cutting.
- Fish feeding experiment.
- Experiment in the use of salmon offal as fish food.
- Ice box built during the past spring.

Recommendations:

- Automobile.
- Kohler Light System.

During the months of September and October of 1929, the installation of a new water system to furnish water for the houses was finished. Owing to the opening of the road between Powers Creek and Alderpoint and the consequent use of the Powers Creek watershed as a picnic and outing ground, and also to the constant fouling of the creek water by cattle and campers, it became necessary to find and develop a new source of domestic water. A spring was opened up and developed at a point about 1500 feet above the houses in the Fort Seward Creek watershed. This spring was enclosed in a concrete box from which the water was piped to a 3000-gallon redwood tank. From the tank the pipe was laid down the canyon to the dwellings. The pipe used is $1\frac{1}{2}$-inch and as this pipe is one-half inch larger than the pipe used in the old system and the head is much greater, we now have a fine supply of good pure water that can not be contaminated and which is delivered at heavy pressure. So far the supply has been more than sufficient for all needs, including irrigation of the grounds at the dwelling.

Fort Seward Hatchery was one of those selected for the feeding experiments last season. As the report made by Dr. Coleman covered the matter fully, it is necessary only to say that the foods selected proved failures at this station. The superintendent desires to stress particularly the experiments made with salmon offal. It is no doubt a valuable and a cheap food, but the use of it is associated with conditions that it will be hard to eliminate and which render the use of it dangerous unless properly handled. These conditions are, first, that the material unquestionably must be frozen solid immediately after removal from the salmon at the packing house and held in a frozen condition until used at the hatchery; second, some container to be used in shipping must be provided to prevent leakage of fluids while the material is in transportation, otherwise, the transportation companies will refuse to accept it.

On the whole. the weather conditions have been dry during 1928, 1929 and 1930. We have had quite a lot of scattered rain during the winters, but none of the normal continuous downpours as in former years. As a result, the creeks have been below normal in flow. This subnormal flow has further been induced by the fact that forest fires in the watersheds have removed the ground cover and the run-off after rains is unimpeded and rapid, very little of the falling moisture sinking into the ground.

Total number of fish distributed from this station during the biennium:

260,730	Rainbow trout.
2,593,350	Steelhead trout.
100,000	Cutthroat trout.
1,261,880	Silver salmon.

PRAIRIE CREEK STATION (Experimental)

This experimental station was established in the early fall of 1928. No major improvements have been made at this station other than the building of a garage. which was a necessity. Only work that was absolutely necessary for the operation of the station has been done, as we still consider the station in an experimental stage and unproven as to either its continuance or as to its abandonment.

The climatic conditions prevailing during the past two years have been so adverse as to preclude an opinion as to the merits of the location as a potential egg supply. One or two bad breaks in the racks have been repaired.

Information from residents of the district is to the effect that there is a good run of steelhead trout in Prairie Creek about once in five years. We have planted the creek heavily during the past two years in the hope of ultimately building up a regular steelhead run in the creek. If we are able to succeed in this endeavor, it will be very good proof of the plan of planting large numbers of small fish instead of a few large fish. A further study is to be made of the streams of the district with a view of establishing dependable sources of egg supply. Redwood Creek has been under consideration for a number of years as a source of supply of salmon and steelhead eggs, but lack of funds to

establish a permanent station have prevented carrying out of plans for this purpose. The United States Fish Commission attempted to establish an egg-collecting station on this stream over thirty years ago, but owing to the small sum of money used in the construction work and the tremendous floods during the period the experiments were carried on, the station was abandoned. With improved methods of trap construction, new roads to available sites, when funds are available this creek should be considered. Redwood Creek is a stream that carries several thousand second-feet of water during flood stages and any work must be of a substantial nature that will stand the high water conditions.

FIG. 17. Taking spawn from a ten-pound Tahoe black-spotted trout. Taylor Creek, El Dorado County. Photo by Joseph H. Sanders.

TAHOE HATCHERY

The operations at Tahoe station have been carried on to its full capacity. Since the construction of the reservoir and aerating system, the spring water has been greatly improved and the fish are making a much better growth during the same length of time than they did when the hatchery was first built. The improvements during the last biennial period consisted of the installation of a power grinding machine for preparing the food and the purchase of a Dodge screen-side truck for the distribution of fish at the Tahoe and Tallac hatcheries.

The distribution for the last two seasons is as follows:

215,000 Rainbow.
269,000 Loch Leven.
377,000 Steelhead.
978,000 Eastern Brook.
998,500 Black Spotted.
24,000 Golden.

TALLAC HATCHERY

We have made a number of necessary repairs at this station, as the cottage for the foreman and the dam and pipe supplying the hatchery were very much in need of repairs. A new dam was placed across Taylor Creek and an 8-inch pipe was laid from the dam to the settling tank. This station is operated during the spring and early summer. The water from Fallen Leaf Lake, that has its outlet through Taylor Creek, gets contaminated during midsummer, and the fish are planted early. The fish make a very rapid growth during the spring and early summer and are large enough for planting early in the season before the water becomes contaminated with organic matter. The cottage was repaired and put in good condition.

The number of fish distributed from this station during the season of 1928–29 is as follows:

310,000 Rainbow.
864,000 Black Spotted.
538,000 Steelhead.
660,000 Large Lake.

BLACKWOOD TANK STATION

This station was established in 1926 for the purpose of relieving the Tahoe Hatchery during the summer and to give the fish a chance to grow to a larger size before distribution. This station has been operated with varying success. One or two lots of trout fry did very well and others did not thrive, owing to the great amount of blossoms that fell in the creek from the aspen and balm of Gilead trees that are growing along the creek banks. These blossoms would gather in large quantities in the stream and decompose, thus polluting the water besides choking up the screens in the holding tanks. A filter has now been installed and we believe that the pollution caused by the blossoms of the trees will not give us any further trouble.

KAWEAH HATCHERY

The Kaweah Hatchery was established as a permanent hatchery during the winter of 1927–28, after operating under a tent for nine years. The last two season's operations have justified the expense of constructing a permanent building and cottage for the help. The water supply comes from the East Fork of the Kaweah River, after passing through the power house of the Southern California Edison Company. It is located on the bank of the main river, where emergency pumps are installed to furnish a supply of water in the event that the power house is shut down for repairs or the flume should be destroyed by fire or other causes. The water is well aerated and of an even tempera-

ture, so that the fish make a rapid development. The fingerlings should be planted early in this section for several reasons. First, the water causes a rapid growth so that the fish are large enough to plant by August, and some seasons during July; second, the aquatic and land insects are in abundance during the summer and early fall so that there is an abundance of natural food for the fish when planted. If the fish are held too late in the fall it is more difficult to plant them. Third, there are no predatory fishes in the streams that are stocked and, furthermore, those fish that have to be carried by pack animal in the higher ranges are in better condition to stand the trip than if held until later in the season.

KINGS RIVER EXPERIMENTAL STATION

Experiments on Kings River were begun in the spring of 1928 to test the water in Kings River between Trimmers and the mouth of the North Fork. A temporary station was operated there during the summer of 1928 with average results. The water was normal during midsummer, and the fish remained healthy and made a rapid growth. As the location was too low for a permanent site, being on a flat subject to floods during seasons of heavy rain and snowfall, it was decided to move the station above the mouth of the North Fork on a flat bordering the South Fork of Kings River. A cottage and cabin for the help were built and a dam constructed across the river; a 16-inch pipe was laid from the dam to the hatchery that was set up under a tent frame, to be changed into a permanent hatchery if conditions are suitable for the erection of a permanent station. Plans are now being made to carry out the necessary changes to make the plant into a permanent hatchery station.

FEATHER RIVER HATCHERY

The operations at this station during the last two seasons have been very successful. There have not been many improvements. A number of improvements are contemplated during the coming season. There should be a garage and a small cabin built for the extra help used during the summer months. The cabin and site should be covered with rustic and papered to make it comfortable. A new settling tank should be built, as well as a filtration tank, following out our plan of installing filtration plants on water supplies that are taken from rivers and creeks.

The principal improvements during the biennium were the placing of rustic on the foreman's cottage and the purchase of a two-ton truck and a light Chevrolet with a truck body.

One million seven hundred thirteen thousand trout have been distributed from this hatchery during the past two years.

BROOKDALE HATCHERY

This station, established in 1905, has been successfully operated during all the years when there was a normal rainfall. The average output has been approximately 700,000 fish per season. The hatchery has furnished trout for Santa Cruz, San Mateo, Santa Clara, and Alameda counties before the establishing of the Big Creek Hatchery on the west coast of the county. Big Creek Station now furnishes fish for a large

part of the district. The hatchery is old and the floor sills, troughs, etc., need repairing, and to accommodate the help a small cottage should be built on the grounds.

The total number of fish distributed during the last two years is as follows:

281,200 Silver salmon.
157,700 Steelhead trout.
143,000 Rainbow trout.

BIG CREEK HATCHERY

This hatchery, established in 1926, successfully operated during the season of 1927. During 1928 an epidemic among the trout fingerlings caused an almost total loss. During 1929 the hatchery was operated,

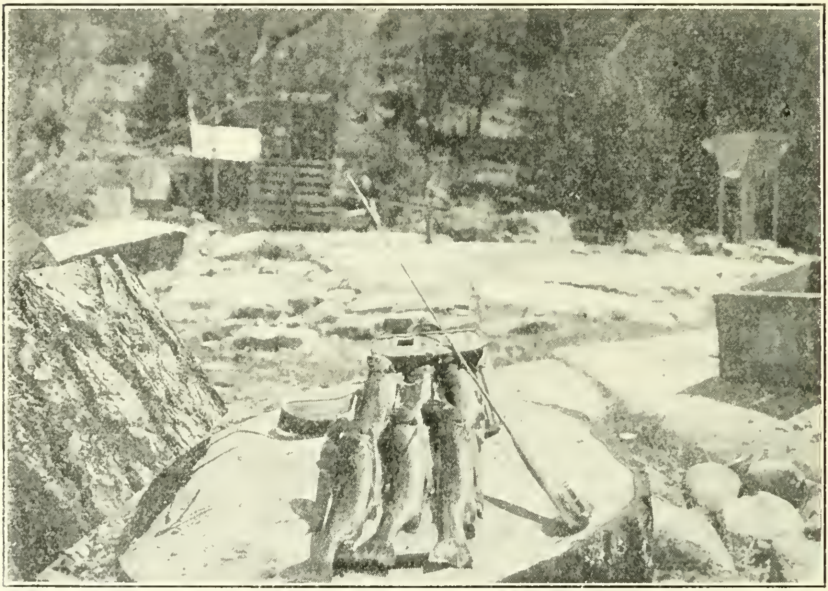


FIG. 18. A limit of rainbow trout taken in Lake Elinor, Yosemite National Park, opening day, 1928. Photo by H. P. Walls.

with no signs of the epidemic of the previous season. The operations during the spring of 1930 have been successful, although the water is very low, owing to the continued drought in that section.

The total distribution from this station for the biennium is as follows:

615,000 Steelhead trout.

SCOTT CREEK EGG-COLLECTING STATION

This station has been operated for the last 25 years. Stocked with fry from the Brookdale Hatchery, the run of spawners was larger during the last two years than it was 20 years ago. Fishing is prohibited in the creek, so that the fish are not caught out by the anglers. The results shown by the history of this station are conclusive evidence of

results that can be obtained by stream closing and proper planting of healthy fish.

There are some repairs necessary to the tanks, dams, etc., that should be made in the near future.

Total eggs collected from this station for 1928, 1929 and 1930, 13,134,000.

MT. WHITNEY HATCHERY

The only major improvement at Mt. Whitney Hatchery during the last two years was the installation of the pipe line to furnish residents below the hatchery their domestic water supply. Besides stopping all agitation among the water users, this improvement will allow us to install additional ponds for holding brood fish. We have been unable to build up a supply of brood fish with only one pond. We recommend that two or three additional ponds for such purposes be built. The cost would be approximately $3,000.

Another improvement that would greatly help the conditions among the men at the Mt. Whitney Hatchery is to have two cottages built on the hatchery grounds. At present the men are sleeping and cooking in different parts of the north wing of the hatchery, wherever room can be made for them. About $4,000 will be necessary for the construction of cottages.

During the last two years approximately one hundred barren lakes have been stocked in Inyo, Mono and Alpine counties from Mt. Whitney and Fern Creek hatcheries. These have all shown good results. A good many of these lakes have been stocked with golden trout.

COTTONWOOD LAKE STATION

In closing the Middle Cottonwood Lake to fishing, we greatly improved our egg take at that station, and we would recommend that several lakes be closed for our spawning operations. This will guarantee us a constant supply of eggs for our hatcheries. If other lakes in this district were closed for different species of trout, all the eggs for this district could be collected without having them shipped in from the outside.

GULL LAKE EGG-COLLECTING STATION

We recommend that one-third or a portion of Gull Lake, in Mono County, be closed to fishing. We have built Gull Lake up for egg-collecting purposes by heavy stocking, but the fishermen catch the majority of the fish before they attain spawning age. The season should close on October 1st, to give the Eastern Brook trout a chance to approach the shore where they can be seined and the eggs collected.

Total eggs collected at this station during 1928 and 1929, 1,445,000.

WALKER RIVER STATION

Last spring we operated on West Walker River and found a good run of fish—Rainbow and black spotted—ascending the stream to spawn. The river was racked off, but owing to the high water at the time the fish were running was unable to handle the stream. We recommend that a permanent dam be built in this stream so that we can handle the water during the run-off. To install an egg-collecting station on this river would cost approximately $6,000.

ALPINE COUNTY HATCHERY

A hatchery in Alpine County would greatly improve the planting conditions in this district, as it is a long haul from Mt. Whitney Hatchery to that section. With a fish planting truck and an aerating system the fish reach the streams in excellent condition, but the trip is too long and too much time is spent in planting.

FERN CREEK HATCHERY AND JUNE LAKE

Heavy plantings of steelhead trout from Fern Creek Hatchery in June Lake are showing up wonderfully this spring. Limit after limit of 8- and 10-inch fish are taken daily. All the fish that were planted in June Lake were put in at about two months old, smaller than most of our plants. We have had better success with these small fish in this lake than we have with larger fish in some of the other lakes that we have stocked. June Lake was first stocked in 1921 with steelhead trout from eggs shipped from the Snow Mountain egg-collecting station on the South Eel River.

We strenuously recommend that the open season for fishing in June Lake, as well as in all lakes in the Sierra Nevada mountains, be on June 1st. Fish taken before that date are spawners and not fit for food. They are taken when near the shore at a time when they are spawning, and the loss is very great not only to the egg-collecting crews, but the fish taken are not fit for food and it should be a crime to catch breeding fish. The laws amply protect the animals and birds during the breeding season, but it is very difficult to get laws to protect spawning fish.

A total of 2,296,000 fish were distributed from Fern Creek Hatchery during 1928 and 1929; and 1,035,000 eggs were collected from June Lake in 1929, and 1,630,000 eggs were collected from June Lake in 1930.

RUSH CREEK EGG-COLLECTING STATION

The excessive fishing in Grant Lake has materially reduced the number of spawning fish that ascend the creek to the egg-collecting station. A later season for fishing should help maintain the run of fish in this creek.

MORMON CREEK HATCHERY

Since the experimental hatchery was established on Mormon Creek, using the water from Springville Mine, there has been an injunction against the mine owners in favor of the small farmers who claimed that the mine had drained the springs on their farms. The mine was ordered bulkheaded so as to close the tunnel drain and force the water to the surface again. This action has materially affected the water supply so that we have only a very small amount escaping from the tunnel. The supply now comes principally from small springs in the ravine above the hatchery and it is contaminated by water flowing into the small stream by irrigation on lands contiguous to the creek. The water is no longer suitable for hatchery purposes. We are planning to remove the temporary hatchery from Mormon Creek to a more suitable site where water conditions are good. As soon as the fish in the hatchery are planted plans for moving the hatchery will be carried out. There are several projects that can be carried out in conjunction

with this plan. One is to have a power company, now constructing impassable dams in rivers near this district, construct a hatchery that will be large enough for the entire district. The other plan is to have certain reservoirs closed to fishing if conditions are favorable to raise a stock of brood fish to supply the hatchery and to have it moved to some centrally situated location where the work can be carried on without interference and where the fish can be distributed throughout the entire region by truck and pack animal. A plan to move the Mormon Creek Hatchery during the fall of 1930 is contemplated and plans are being made so that the work can be finished before the season for shipping the fall eggs for that district.

COLD CREEK HATCHERY

The operations at this station during the last two seasons have proven that the selection of this site was a good one. Considerable work has been done in and around the hatchery since it was completed in the spring of 1928. The grounds around the hatchery were leveled, a breakwater was constructed on the banks of Cold Creek to prevent erosion during periods of high water, as the bank was being cut away rapidly and in a few years would have caused damage to the hatchery and grounds. The head trough or distributing tank was remodeled, shrubbery and flowers have been planted, greatly improving the attractiveness of the grounds. An emergency pump to be operated during the early spring when it appears necessary that the water supply for a few weeks should be augmented by a flow that is free of algae should be installed as the algae causes considerable trouble when it is running in the creek before the warm weather sets in. It may be that one of the filtration tanks that we are planning to install at many of the hatcheries will eliminate the trouble. A sand box and discharge gate in main pipe line will be arranged for and built this coming fall.

The fish have made a remarkable growth and have all been free of infection, except a shipment of Atlantic salmon that were lost this spring. The loss was attributed by the foreman to the algal growth in the creek, but this has not been proven as the Atlantic salmon raised at this station during the season of 1929 were exceptionally strong and vigorous and were planted in Smith River without any noticeable loss when they were from four to five inches in length. Reports from Canada, where the Atlantic salmon are propagated on a large scale, would indicate that they are a very difficult fish to raise, being nonresistant to ordinary hatchery conditions and only with the greatest skill can they be raised successfully.

Next season experiments will be made at several stations, if we can procure the eggs, to determine whether the Atlantic salmon can be raised with ordinary hatchery methods. While we were very successful with the first lot, reports would indicate that they are a very delicate fish and are not resistant to certain pathogenic conditions either on the Atlantic seaboard or in Europe.

SNOW MOUNTAIN EGG-COLLECTING STATION

This egg-collecting station, located on South Eel River, has been in operation for the last 25 years. It has furnished during seasons of normal rainfall a fine lot of steelhead trout eggs. Since the construc-

tion of Lake Pillsbury there have been several seasons when the spill-over came too late or the lake did not fill in time to allow sufficient water to flow down the river to the Cape Horn Dam and from the Cape Horn Dam through the fishway to the tanks at the egg-collecting station in sufficient quantity to allow the successful operation of the station. During the spring of 1929 the season was short owing to the drought, and the station was not operated during the spring of 1930 as conditions were still unfavorable. There is a demand from the local anglers and others that a portion of the run be allowed to pass above Cape Horn Dam to furnish fishing for the anglers when the season opens. Plans are being made to allow 50 per cent of the fish that ascend the river to pass above Cape Horn Dam during seasons of normal rainfall. We are arranging to operate this station with this plan in view.

The total eggs collected from the station during 1928 and 1929 are as follows:

1928—2,100,000 Steelhead eggs.
1929—2,875,000 Steelhead eggs.

SOUTHERN CALIFORNIA HATCHERIES AND PONDS

The most important improvements during the biennium in southern California have been the building of the Snow Creek Hatchery and the construction of the Rincon Pond station, also the moving of the Santa Ana Hatchery.

BEAR LAKE DISTRICT

In the Bear Lake district the most important factor is the planting of the fish. Last year 250,000 black spotted trout eggs were shipped to this district and were held over in a pond on Metcalf Creek by the Izaak Walton League, and the pond opened into Bear Lake this spring. There is no way of telling just what the results will be of the fish released into the lake. Thirty to thirty-five years ago, black spotted trout were planted in Bear Lake and thrived remarkably well. A good percentage of the fish were liberated from the pond owned by Bartlett Brothers, but the outlet to the pond was situated so that the pond could not be drained, and an estimated number of about 30,000 were left in the pond. The number estimated as liberated and left in the pond is an approximation only.

During the year of 1929 a total of 1,124,552 eggs were taken at Bear Lake; 140,000 of these were transferred to the San Gabriel station. The balance was held at the Bear Lake Hatchery and the Santa Ana station. A total of 507,000 fish were planted from the Santa Ana station and a total of 507,300 were planted from the Bear Lake Hatchery. Most of these fish were planted in San Bernardino County, and 140,000 were planted in Los Angeles County.

The fish planted in the district were given a wide distribution and, as much as possible, checks are being made this year on the plants showing increases in the number of fish taken. Nearly every stream in the district reports good catches. The trout fishing in Bear Lake has been better this year than any time since 1924, with quite a number of small fish taken. The policy of holding the plants for Bear Lake until December is showing good results.

Bear Lake did not show very favorable results in egg-collecting work this year, due to the very poor spawning conditions. A total of 505,000 eggs were taken, but most of the eggs taken were from young fish—very few of the old spawners being caught. To fill up the allotments for the whole southern district, eggs were shipped from the northern part of the state.

ARROWHEAD LAKE EGG-COLLECTING STATION

The first of this year (1930) an agreement was made with the Arrowhead Lake Company regarding the taking of Rainbow eggs at Arrowhead Lake with a 50 per cent return to Arrowhead Lake for stocking. One million two hundred ninety-six thousand eggs were taken this first year, and under poor spawning conditions. Much better results can be had in a normal spawning year. This has opened a new egg-collecting station in this district.

SANTA ANA STATION

The moving of the Santa Ana station from Forsee Creek to the new location at the mouth of Barton Creek on the Santa Ana River is a marked improvement in this district. There is a large supply of water at the new location and the fish placed in this station this season are showing a very good growth. The fish planted from the Santa Ana station the last two years have shown good results and the fishing conditions in the Santa Ana watershed are much improved.

RINCON PONDS

These ponds are located on the North Fork of the San Gabriel River and consist of four ponds 10 feet by 50 feet by 6 feet in depth, and one pond 44 feet by 18 feet by 6 feet deep. On the completion of the ponds the trout, to the number of 160,790, three to five inches in length, were transferred from the San Gabriel station and placed in the ponds after being segregated into three sizes to prevent cannibalism. These fish were placed in the ponds in excellent condition on March 5th. On March 20th a road construction crew fired some heavy blasts in close proximity to the ponds and caused a crevice to open in the faulty ground in the bottom of the dam that diverts the water into the supply pipe and, despite all the efforts of the road crew and hatchery men, they were unable to close it in time to prevent the fish from becoming exhausted from lack of fresh water. Efforts were made to aerate the water but after a few hours this was given up and the fish released into the river. Several hundred were caught up after the dam was repaired and placed in the pond, where they are making a rapid growth.

There is twice the amount of water at this station as there is at the San Gabriel station. San Gabriel station should be moved to the new location in the near future. Also, there is a cabin at the lower end of the ponds and the owner is planning to build a new house west of this. These places are on government leases and if this cabin can be purchased this should be done, giving us a house for the helper at the pond station. These are the most important improvements at the Rincon station that are recommended at this time.

NORTH CREEK EGG-COLLECTING STATION AND HATCHERY

Owning to low water in North Creek and general low water in Bear Lake tributaries, it was not necessary to operate this station during the last two seasons. We have planned to have the station repaired and put in order so that when conditions are more favorable the station can be operated the same as it has been for the thirteen years prior to 1928.

SAN GABRIEL STATION

This station was established in June of 1928. Ten tanks were built and a number of hatching troughs erected for use at this tank station. The results obtained were very good, 210,000 Rainbow trout being held in the tanks until the spring of 1929, when they were liberated in the North Fork of the San Gabriel River. They were from three to five inches in length and did not scatter very well. The majority of them

FIG. 19. Up and over. A steelhead trout jumping the fishway at Snow Mountain Dam on the South Eel River. Photo by E. S. Cheney, February, 1930.

remained in the creek within a distance of approximately three miles of the hatchery. During 1929 715,000 were held in the tanks and some were distributed in the tributaries of the San Gabriel; 160,000 were held until March 5, 1930, when they were placed in the New Rincon Pond system where they were held for a short time until the water was shut off by the damage to the diverting dam caused by heavy blasting, and all but 1900 fish were released into the river.

SNOW CREEK HATCHERY

The Snow Creek Hatchery was completed in May of this year and 400,000 Rainbow trout placed in this station are showing a very good

growth so far. They are growing so fast that plants will have to be made very soon, to make room. With two ponds completed at this time, if the Commission wishes to hold a larger number of fish at this station, additional ponds will have to be constructed. This is the most important change to be made, but some work should be done on the dam at the head of the diversion ditch from which we take our water supply to insure us of an unfailing water supply.

CLEAR CREEK AND DOMINGO SPRINGS HATCHERIES AND EGG-COLLECTING STATIONS

At Clear Creek Hatchery a live pen and supply flume, size 12 inches by 18 inches, and 380 feet in length, was constructed during October of 1929. Repairs were also made to the supply dam. Forty new hatching troughs were constructed at Domingo Springs station during May of 1929, in order to handle an additional million Rainbow trout. These troughs are covered by a tent. A new rack and trap was constructed during August of 1929, but replacement of this work was necessary during December of that year due to a heavy flood. A new live pen at least 40 feet by 8 feet by 7 feet in size should be constructed at this station. The present live pen is too small to accommodate the number of fish caught and is in very poor condition. Construction of a new flume 12 inches by 16 inches and 260 feet in length will be necessary for the live pen and hatching house supply.

BUCKS RESERVOIR EGG-COLLECTING STATION

It is recommended that a new trap be constructed in each of the three creeks flowing into Bucks Reservoir. This reservoir will produce a million to a million and a half Loch Leven eggs per year. If plantings of Eastern Brook trout could be made in this lake, we believe that a run large enough to produce a million eggs could be developed if this reservoir could be closed. Fish planting has been carried on successfully during the past two years, and 575,000 eggs were collected during the past season.

YELLOW CREEK

A great many small Loch Leven, measuring about 3 to 4 inches in size, are being taken by fishermen in the headwaters of Yellow Creek this season. These fish are no doubt the last year's Loch Leven which were planted there, and we believe it would be advisable that the portion of Yellow Creek lying directly opposite the Longville Hotel and for a distance of two miles downstream be closed to fishing. This part of the creek is one of the most accessible places to make the Loch Leven plants on this stream and we believe it would be of considerable benefit if it was closed to fishing to allow the young of these fish a chance to develop.

WARNER CREEK EGG-COLLECTING STATION

This station continues to give the regular quota of eggs each season. Considerable repairs and improvements have been made during the last two years, particularly in the fall of 1929, when a holding tank was built and new traps constructed, racks and flumes repaired. This station is situated at the mouth of Warner Creek, a tributary of the

North Fork of the Feather River. The spawning fish ascend the river from Lake Almanor and enter Warner Creek where a large number of Rainbow eggs were collected each season for the last ten years. The run of fish in all the tributaries of Lake Almanor are, except Hamilton Branch, as large if not larger than they were ten years ago, despite the heavy fishing in Lake Almanor. The total number of eggs collected from Warner Creek Station during the last two seasons was 2,965,000.

MUD CREEK EGG-COLLECTING STATION

This is a comparatively new station. Plans were made several times in the past to install traps in this creek, but the bed of the stream near the mouth where it empties into Lake Almanor made it a difficult problem until the surface of Lake Almanor was raised, backing the water to a higher level where a trap could be installed with safety. This was successfully done two years ago. The total number of eggs taken from this creek during the last two seasons was 1,075,000.

YOSEMITE HATCHERY

Successful work has been carried on at this hatchery since it was first operated in the spring of 1927. Owing to conditions of the water, considerable skill and care must be exercised by those in charge of the work to get a maximum of results, but during the three seasons that this station has been operated the results have been equal to the average of all fish cultural stations in this state. We have propagated all species of trout that are handled at the California hatcheries, as well as a successful hatch of grayling eggs that were received from Montana. The grayling eggs were shipped to the Yosemite Hatchery as well as to the Tahoe Hatchery as an experiment to determine whether this species can be successfully introduced into the waters of the high Sierra. Attempts were made several years ago to introduce the grayling and after several years of planting in favorable places no results were obtained except in the ponds at the Mt. Shasta Hatchery. There several thousand were raised to adult size, but the fingerlings and fry planted in a number of streams and lakes were not seen again. They were planted in waters that were not inhabited by other species of fishes as well as in streams and lakes in which other species were found, but the work failed to produce any results. We are hoping that this attempt now being made at Tahoe and Yosemite hatcheries will be more successful.

Four rearing tanks have been added to the hatchery, grounds improved and show ponds constructed during the past two years. A meat and ice house will be constructed in the near future. A woodshed and garage should be constructed at this hatchery.

Following is a list of the fish distributed from the Yosemite Hatchery during the seasons of 1928 and 1929:

440,700 Rainbow trout.
276,000 Loch Leven trout.
743,500 Steelhead trout.
203,200 Eastern Brook trout.
48,000 German Brown trout.
203,500 Black Spotted trout.

WAWONA HATCHERY

This station was not operated during 1930 as the loss among the fish for the last two seasons was above normal, owing, no doubt, to the contamination of the water by the great number of campers on Big Creek from which the hatchery received its supply. Investigations will be made to determine whether another supply of water can be had at a reasonable expense from springs or the South Fork of the Merced River, above the Wawona Hotel property. The prolonged drought also has had its effect upon the water supply of Big Creek as well as many other streams.

BASS LAKE TANK STATION

The Bass Lake Tank Station in Madera County was established during the spring of 1930 at the request of the citizens of Madera County. It is located on the North Fork of the San Joaquin River, a tributary of Bass Lake, formerly known as Crane Valley Lake. The tanks are to be used to hold the fish so that an easier and better distribution can be made to the waters in the mountainous regions above the lake. The station consists of ten tanks, furnished with a good supply of water, where the fish can be kept in good condition until the planters can carry them to the waters to be stocked and not have to be rushed in the distribution work. This distributing station will greatly assist the fish planters in that section. There are some improvements contemplated to complete the station during the coming year.

The forest supervisor of the Sierra National Forest assisted in the selection of the site as well as giving the employees of the bureau information regarding climatic conditions, seasonal changes, roads, trails, etc. The employees of the forest service and of Madera County constructed the road from The Falls to the site of the tank station on the North Fork of the San Joaquin River.

SALTON SEA

At the request of the residents of Imperial County, the El Centro Chamber of Commerce, and particularly Assemblyman Myron Witter of Brawley, and Robert Hayes, secretary of the El Centro Chamber of Commerce, that some game fish be introduced into Salton sea to improve fishing conditions, the Bureau of Fish Culture recommended as an experiment that striped bass (*Roccus lineatus*) be introduced, as it was considered possible that this species might propagate and increase by spawning in the tributary streams that enter the south end of the sea. Later on, Mr. George Coleman was sent down to investigate the food supply for this species, as well as to make other biological studies. During the fall of 1929 2400 yearling striped bass were safely planted in the Salton sea off the shore of Calipatria. It is hoped that suitable spawning conditions exist in New River and Alamo River for this fish to propagate. If this species does not thrive, other game and food fishes will be experimented with.

EXPERIMENTS IN FEEDING TROUT FRY

An important experiment was conducted by George A. Coleman, biologist of the bureau, to determine what foods might be used which

would reduce the cost of materials and handling, and still produce results comparable with beef liver.

Results of these experiments have been published in the January, 1930, issue of CALIFORNIA FISH AND GAME, and are also available as a bulletin, so are not reproduced here. The conclusion reached was "That nothing has appeared in the course of experiments that even approaches in value raw beef liver as a food for young trout."

RECOMMENDATIONS

A shorter season for the taking of trout in the Sierra Nevada as well as the coastal regions.

An earlier opening season could be had on the coastal streams, from Humboldt County south to Ventura, if the streams were closed to fishing in the early fall.

We renew our recommendations that ponds for the rearing of brood fish be constructed as soon as funds are available.

We urgently request that every effort be made to have the season open June 1st in all districts of the Sierra mountain range. The open season before June 1st is destructive to thousands of spawning fish that are not fit for food when caught.

The tributary streams to Lake Tahoe should be closed for at least six years longer to enable us to build up the supply of fish in the lake.

Several million steelhead and Rainbow trout should be planted in Lake Tahoe each season. Such a large body of water requires that a great many fish be planted for a period of years before lasting results are obtained.

We recommend the closing of several lakes for the purpose of procuring more eggs to furnish the hatcheries.

Ponds should be built for the raising of brood stock to furnish eggs and have them properly located and placed in the hands of trained fish-culturists so that best results may be obtained.

The eggs purchased from the private hatcheries are of poor quality in the majority of cases and do not produce the best results. There are too many untrained and impractical persons attempting to furnish the market with eggs. It is up to the state to get as many eggs in good condition as possible. This takes a great deal more money than the present license fees will furnish.

We recommend an increase in the angling license fees. If the people desire more fish they must furnish the money to propagate and conserve them. It is impossible with the present angling license to operate all the hatcheries, collect the eggs, hatch them, and rear and distribute the fish in all the lakes and streams in this great state for the small license fee of two dollars a year. New hatcheries must be built, ponds constructed, biological and stream surveys made, new distribution cars, trucks, and pack animals must be provided and trained fish-culturists and fish planters employed, so that the many thousands of lakes and thousands of miles of rivers and creeks can be stocked and properly patrolled. The season for taking trout should be arranged by the legislature so that no fishing would be allowed until the spawning season is over, regardless of the clamor of those who desire to catch spawning fish that are not fit to eat and that are easily caught during the breeding season. Our game laws are passed so that the breeding

animals and birds are protected during the time they are having and caring for their young, but not so with the fish, particularly the trout. We have recommended to the legislature for many years that the season on trout be kept closed until the majority of the fish were through spawning, but when some selfish interests protest that they must have an earlier season, it is generally given to them to the destruction of the breeding fish. Persons who will catch spawning fish, when they have to a great extent lost their instinct of self-preservation during the time that they are in the act of propagating their species, are devoid of the finer sensibilities of civilized human beings. They seem to think and act as if the trout and salmon should be destroyed at this particular period of their existence, instead of assisting in their protection so that their progeny could later on be used for food and sport.

The use of salmon eggs and the eggs of other fishes for bait should be prohibited, as no more destructive methods could be used than the use of fish eggs for bait. The small, immature fish are taken and not given a chance to develop. The use of salmon eggs as bait is increasing and as the idea spreads among the bait fishermen, they are learning that the eggs of inferior species of fishes can be successfully used as bait and that they do not have to buy salmon eggs. The use of the ova of any species of fishes should be prohibited as bait.

Under the guise of sentimentalism, many advocates of the use of salmon eggs claim that the passage of such a law would deprive women and children of the pleasure of fishing. This is not a fact as there are many kinds of natural bait that can be used if a person does not desire to use a fly or spoon. Those advocating the use of salmon eggs are actuated by a selfish motive to catch as many fish as possible regardless of size. These persons are backed up by those who are getting a profit from dealing in salmon eggs for the trade. It is not the women and children that are being considered but a pecuniary interest of those who are dealing in eggs, and the persons who will take fish regardless of size, to the detriment of all anglers who desire to catch and enjoy a mess of fair sized fish, are not true sportsmen.

We recommend that some action be taken by the state in conjunction with the counties to open highways, trails, or roads along all streams not flowing through cultivated lands so that the persons who are closing the streams by leasing or purchasing lands for the exclusive use of themselves and their guests will be prevented from denying to the public the right to fish in the streams and lakes of the state that are rightfully the property of all the people regardless of who owns the wild land through which the streams flow. Section 4085½ should be amended so that the state can cooperate with the counties in purchasing the right of way for the purpose of fishing along the streams and lakes on wild lands. There have been several instances where persons have leased or purchased wild lands along streams and fenced them in and cultivated a small piece of land near the bank of the stream, thus claiming that these lands were cultivated lands so that the provisions of section 4085½ could not be applied. This should not be allowed. The section should be amended so as to apply only to bona fide farms or to lands cultivated for a beneficial purpose and not for the purpose of evading the law.

We recommend that in addition to the valuable work being done by the Bureau of Fish Rescue and Reclamation, ponds be established for the propagation of the spiny rayed fishes as well as for catfishes so that several millions of these species may be planted each season in the rivers, sloughs, and ponds in the warm water regions of the state; that is, throughout the great central valleys where these species thrive, so that more of them could be raised beneficially and placed in regions where excessive fishing appears to have reduced their numbers. Before entering on this program, a close study should be made to determine whether this is necessary. There is a question whether these species are in need of pond culture to keep up the supply or not. The large mouth bass, in all probability, should be increased by pond culture for the benefit of places where they are being fished very heavily. The small mouth bass was planted extensively throughout the state between thirty and forty years ago. They increased for a number of years, but owing to changed climatic conditions and physical properties of the waters in this state they have gradually disappeared and only scattering remnants of these fish are to be found in a few localities, where they were numerous a quarter of a century ago. It is doubtful whether they will ever thrive again in the waters of this state, as conditions are not suitable for this species. The large mouth species finds a natural habitat throughout the great central valleys of the state and are a valuable asset to the food and game fishes in California. Efforts were made to collect a shipment of the small mouth species last fall and winter from places where they were numerous twenty-five years ago, but after repeated and earnest efforts to collect a sufficient number of the small mouth species only a few were taken.

During the spring of 1930, Mr. George Neale, director of the Bureau of Reclamation and Rescue, succeeded in getting 1500 small ones of this season's hatch and placed them in ponds near Oroville, where an attempt will be made to procure enough young of this species when they arrive at maturity and become breeders to again stock the lower reaches of some of the principal rivers in the foothill regions. If more are found this season, they will be transplanted where conditions appear favorable, but these places are not very numerous owing to the present conditions of our rivers and streams as well as the ponds and sloughs that are now taken up by the large mouth bass that thrive in these waters. However, the rapid waters of the lower stretches of our rivers might prove favorable for small mouth bass transplantation.

The statistical report of the fish distribution for the season of 1928 and 1929 will be found in the appendix.

REPORT OF THE BUREAU OF HYDRAULICS

By John Spencer, in charge

The thirtieth biennial report for the years 1926–1928 gave a brief outline of the formation and methods of operation of the bureau. The operations for the thirty-first biennium have practically been in accord with that procedure and in other respects no material changes have occurred. The patrol forces furnish much of the initial data for actions taken by the bureau and the friendly and cooperative spirit evidenced is much appreciated and is an important factor in the progress of the work. Some measure of return is given in that when installations of fish screens and fish ladders are effected or repaired, or pollution of public waters obviated, favorable local sentiment is engendered to a degree for the application of the fish and game laws without favor and greater respect for the deputy.

When the bureau was first organized much opposition was apparent when efforts were made to have screens or ladders installed. It can not be said that at this date opposition to the program of the Division of Fish and Game, as it pertains to this bureau, has been entirely overcome, and it is doubtful if such a condition will ever be realized as costs of screen and ladder installations or the prevention of pollution are moneys expended which give no tangible return to the party required to make the expenditure. There is seen, however, more of a willingness to consider and discuss the matters connected with these installations. Every effort has been expended to call for installations in their order of importance to fish conservation and the bureau has assisted in all ways possible. The law must be applied impartially or there can be no measure of success to a screen or ladder installation program.

FISH SCREENS

In the last two sessions of the legislature efforts were made to amend the present fish screen bill, section 629 of the Penal Code. Had these amendments carried section 629 would have been of no value or the cost would have been passed on to the Commission. Similar measures no doubt will be introduced in the future, but with the facts at hand such procedure should cause no concern. If section 629 can not stand the test of examination then it should be amended.

The preceding biennial report referred to criticisms made of the screens in use by the Commission and the results of a conference called by the Commission of irrigationists and power companies in April, 1926. The two committees appointed at that time to study fish screens have not as yet given the Commission the benefit of any findings. It may be inferred that the criticisms of fish screens are not founded on fact, but the evidence of a more definite spirit of cooperation would be highly desirable.

Examinations of diversions have been made in the past biennium as needed, some fish screens installed and repairs made of existing screens so that they would be fully efficient. Probably the most valuable fish

conservation work done in this period was that in connection with the effort to have a fish screen installed by the Glenn-Colusa Irrigation District on its diversion from the Sacramento River north of Hamilton City. After conferences had failed to effect the desired installation, legal action was recommended which finally resulted in a superior court trial in May, 1930.

The matter was submitted on briefs. The evidence at this trial showed that the district diverted a maximum of about 1800 cubic feet per second of water (one-half or more of the river flow in summer) from the Sacramento River by means of large diameter pumps, and irrigating about 140,000 acres. The estimates of cost of screen installation by the Commission were from $10,000 or less to $11,800 (the latter figure being a contract price) and in excess of $35,000, as testified to by the district witnesses. In addition to saving fish the proposed screen would keep trash and debris from going through or lodging in the pumps and at times necessitating repairs. Mr. N. B. Scofield, in charge of the Department of Commercial Fisheries of this Commission, testified that the take of salmon eggs on the Sacramento River was now only one-fifth of what the take was 20 years ago, and most of this great decrease was attributed to losses due to unscreened pumps and diversions, and if salmon and other commercial fish were to be saved to the people of the state screening of diversions must be done. The Commission introduced, by reports and witnesses, that as a result of 120 days of netting operations below the pumps, the area netted being from less than 1 per cent to 3 per cent of the total canal area, 5575 fish had been caught, about 66 per cent of the salmon caught being dead or injured; and all shad, adult and fingerling were killed or injured due to passing through the pumps.

It is seen from the foregoing brief summary that great losses of fish life do occur due to unscreened diversions and that costs of protection are not unreasonable and must be carried out if a valuable asset of the people of the state is not to be destroyed. If a favorable decision is received from the court the work of the bureau will be greatly aided, but in any event the decision will indicate the course of fish conservation with respect to the present screen bill.

FISHWAYS

The work of checking existing fishways has been continued during the biennium with the view of having existing structures fully effective and new surveys have been made for further installations when the data warranted such procedure. A number of fishways for which surveys and plans were made in the preceding biennium have been completed and are now in operation.

As a result of these installations, improvements and repairs, a larger number of fish have been seen above the dams on which these fishways are located than experienced for a number of years. A few obsolete dams have been blown out or passageways made for fish. The reconstruction of the fishway at the Mendota Weir by Miller and Lux on the San Joaquin River was accomplished and it is reported that more salmon passed this point this year than for a number of years past. Work is going forward on a fishway at the Merced Falls dam of the San Joaquin Light and Power Corporation on the Merced River. This will open up several more miles of stream bed to spawning fish.

Court action is in process in a number of cases. Every effort is made in both screen and fishway matters to have installations made without recourse to court action, but when these efforts fail the bureau recommends prompt legal action.

Progress is being made in bringing data on dams in the state up to date. The first concern is to obtain a complete list of all dams so that a determination may be made as to what, if anything, will be required of the owners. This work will take considerable time and effort as it is of some magnitude.

In 1926 publicity appeared in the press regarding the alleged satisfactory operation of a fishway and mechanical lift at the Baker Dam, on the Baker River at Concrete, Washington. This dam at that time

FIG. 20. Natural conditions utilized in the construction of a fishway. Note steelhead ascending in foreground.

was 200 feet in height and intercepted a large salmon migration. In December, 1926, the International Pacific Salmon Investigation Federation passed a resolution condemning the publicity as not being warranted by the facts. It is now generally admitted that the operations at Baker Dam are a failure with respect to protecting the salmon run. It is possible that means may be devised for passing fish over or around high obstructions and the safe return of the seaward migrants, but such means will be accomplished only when a very definite and active cooperation exists between the biologists and engineers, the former in the main being or representative of the conservation agencies and the latter in general being representative of the owners of the structure.

From present information the construction of fishways is limited by height and possible other factors and hence a study should be made to see if present data on the subject may be accepted as final. The prob-

lem is becoming more acute in view of the present tendency to construct high dams at or near the floor of the valley. If construction of these dams continues and no satisfactory way of passing fish over or around these dams is found a very marked effect will be experienced on the amount of anadromous fish in this state. It may be that fish culture methods may solve the problem but the burden on the state will be great.

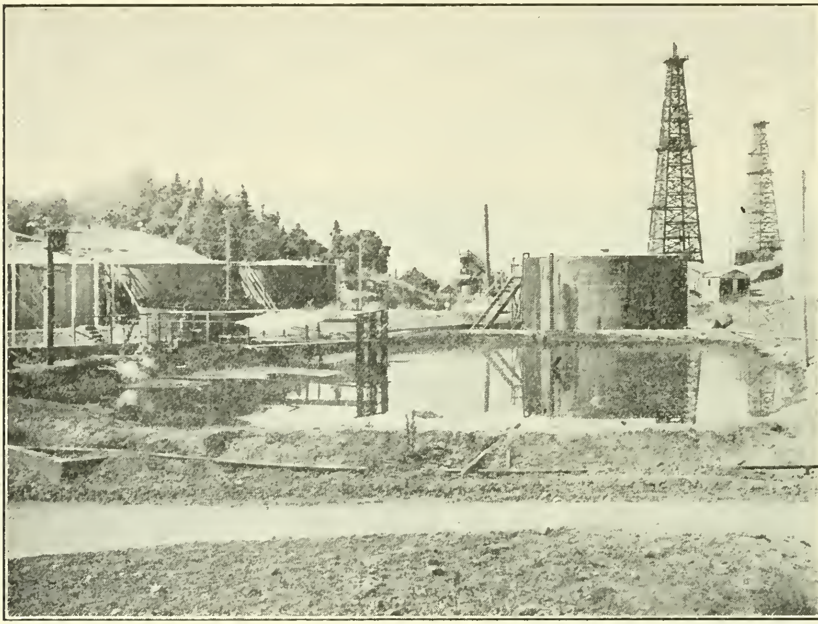


FIG. 21. Old type of individual oil sump with earth levees used in preventing oil pollution

PREVENTION OF POLLUTION OF PUBLIC WATERS

The apparent general public interest in this phase of the bureau's activities is very evident and no doubt has a material bearing in effecting improvements. The conservation agencies, press, and public are aware of the dangers if pollution of public waters were permitted to continue. We are concerned with pollution only in so far as it may be deleterious to fish or plant life, but when that stage of cleanness and purity of water exists so that fish and plant life thrive many indirect results accrue to the general public, clean beaches and shore line being very noticeable, especially in the summer season.

The tendency of people, industries and cities is to pass the wastes into creeks, rivers or ocean waters with little regard, if any, for the consequences upon their neighbors or water-borne life. Only by continued education and reasonable application of the laws governing the discharge of these wastes may improvement be effected.

In the past biennium we have been fortunate in receiving the continued cooperation of the oil industry in general, to the end that oil pollution from shore operations has been reduced to a minimum, and when accidental breaks occur, as will happen now and then, efforts are

made to minimize the ill effects or entirely clean up. California is one of the three leading oil producing states, and at times the leader, yet the public waters of the state are very free of oil. This satisfactory condition would have been very difficult of attainment had not the oil industry cooperated with and conformed to the wishes of the Commission. To show the change that has occurred the conditions at a couple of points in southern California may be cited. When the work was first started an inspection showed that the lots and even the streets of Signal Hill and Huntington Beach were in many cases covered with oil. At the present time no oil is seen in the streets and seldom on the lots. Had the oil stayed on the lots and streets the Commission would not have been concerned, but at the first rain the oil would float off and find its way into public waters. Sometimes the quantities were such that rain was not required. Oil Operators, Inc., was formed at Signal Hill to take care of the waste oil, mud, sand and salt water, and subsequent to start of operations in 1927, has continued to function in an efficient manner. Huntington Beach was in a somewhat similar condition, but a cleanup was effected and now a move has been initiated to provide an organization similar to Oil Operators, Inc., and two others, mentioned later. In addition it is proposed that prospective operators be required to give a satisfactory bond as to disposal of wastes before the city issues a permit for drilling.

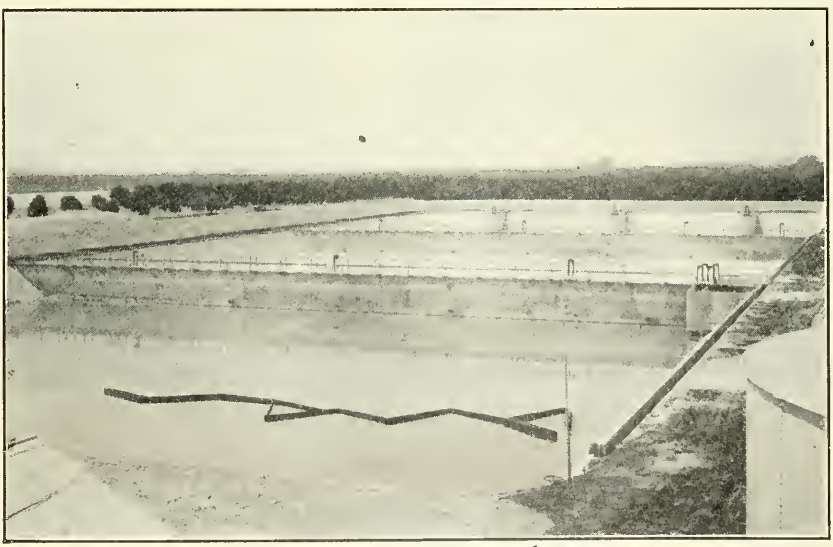


FIG. 22. New type of sump. Part of a cooperative reclaiming system costing about $300,000 which is now in operation in southern California. By such prevention measures, the various oil companies are aiding in preventing pollution of state waters.

To satisfactorily take care of the wastes from Orange County and Santa Fe Springs oil fields two companies were formed, plants constructed and placed in operation at a cost of about $700,000. These concerns, composed of the participating oil companies, are known as the Waste Water Disposal Co., and the Santa Fe Springs Waste Water

Disposal Co., respectively. If the Oil Operators, Inc., is included the plant costs exceed $1,000,000. When these plants were placed in operation a formal opening was held to which public officials and others were invited. A large gathering inspected the plants. Since the plants have been in operation the discharge waste waters have been satisfactory.

Individual companies have expended much money to prevent pollution, but detailed mention would unduly lengthen the report. It may be conservatively stated that about $4,000,000 has been expended by the oil industry to prevent oil pollution subsequent to January, 1927. With few exceptions, and these mostly of smaller operators, the

Fig. 23. Reinforced concrete construction of an oil sump, showing portion of one compartment.

improvements have resulted from conferences. Court action is not resorted to unless warnings have not been heeded or the pollution is evidently wilful and in defiance of the known law.

It has been necessary to file 26 complaints for pollution (all classes) in the past biennium. With the exception of four all may be said to have resulted favorably to the Commission.

The drilling for oil on beaches and tidelands is a source of potential pollution. When oil escapes from oil wells so situated remedies can not be readily contrived and while wells have been so located and little pollution occurred, yet when in the hands of an operator not so considerate of the law, application of remedial measures becomes most difficult. On May 28, 1929, Gov. C. C. Young signed an act prohibit-

ing the issuance of any additional permits to drill for oil on state-owned beaches or tidelands.

The lumber industry has received the attention of the Bureau with the result that ill effects from debris in mill ponds have been minimized and wastes have not been allowed to pass on down stream. In most of these cases the costs of improvements were not great, though fish life in the streams below will be greatly benefited.

Other lines of industry have been contacted and practically in all cases remedial measures were taken by the concerns where pollution was occurring. Gas plants, steel mills, fiber plants, laundries, mines, packing plants, wineries, canneries, and creameries indicate the range which this work takes. Each is a problem by itself and must be so considered.

RECOMMENDATIONS

The continued further diversions of water in this state increase the problem as to the preservation of fish life and it would appear that a study of possible ways to minimize the damage accruing from the continual encroachment on fish life by these diversions would be of benefit with the view of obtaining the greatest benefit from the diversions and at the same time utilizing or retaining these waters for the preservation and addition of fish life.

I would recommend that a study of sections 629 and 637 of the Penal Code be made with a view of simplifying legal action in the installation of fish screens and fish ladders, respectively, when same is required, so that such installations would be expedited.

REPORT OF BUREAU OF EDUCATION AND RESEARCH

By H. C. Bryant, in charge

PERSONNEL

The staff of the Bureau of Education and Research at the end of June, 1930, numbered eleven. Following the resignation of Roy Ludnum on November 20, 1928, the Bureau of Research, which temporarily had been operated separately, was reallocated to the Bureau of Education, and from this date onward all game research work has been supervised and the word "research" added to the name of the bureau.

George Holmes, who had been employed as lecturer in the schools, resigned on September 15, 1928. His place was not filled.

In the fall of 1928, it seemed advisable to change the method of securing motion pictures, which had been on a footage basis. E. S. Cheney, an experienced photographer, was employed on half time, and he has furnished a continual increment of both stills and motion picture films.

Dr. Henry Van Roekel was secured as a pathologist on June 1, 1928, and served capably until July 31, 1929, when he resigned to take a responsible position at the State College of Agriculture, Amherst, Massachusetts.

Dr. E. C. O'Roke acted as parasitologist for more than a year, severing his connection on August 31, 1929, to accept a position as assistant professor at the University of Michigan, College of Forestry and Conservation. Beginning in late February, 1930, Gordon H. True, Jr., was employed to carry on parasitological research and in particular to determine some means of preventing damage by deer to orchards.

Paul A. Shaw was employed beginning November 1, 1928, and was given the important work of finding the cause of duck disease. For a short period in the spring of 1930 he was furnished a technical assistant.

A continuing problem through the years has been that of the predatory animal. E. L. Sumner, Jr., was employed on January 1, 1930, to undertake researches on the status, depredations and interrelations of predatory animals.

The Bureau of Public Relations was merged with this bureau on December 10, 1929, at which time Leo K. Wilson was employed on part-time to care for this important work. June 13, 1930, Earl Soto succeeded Mr. Wilson in handling this work on a full-time basis, and Mr. Wilson assisted in other capacities.

Owing to the size and scattered activities within the bureau it was found desirable to hold staff meetings. This gave opportunity for staff members to become personally acquainted and to understand the aims of the bureau and its interrelations.

EDUCATION

Lectures. There has been continued effort to emphasize educational work in the schools. As indicated by the table which follows, a

large number of the high schools have been reached with lectures as well as numerous elementary schools. In almost all instances, motion pictures were used to illustrate the lectures. Furthermore, endeavor was made to stir the interest of teachers in wild life conservation and when lectures were given, teachers were asked to follow up and determine how much children had learned. Records also show that most of the teachers' colleges of the state made use of our lecture program. This is a particularly fruitful field in that prospective teachers receive instruction.

Though a considerable total of lectures were given in the San Francisco Bay region, there was a determined effort to reach mountain counties and out of the way places. Numerous lectures were purposely planned in southern California. Bureau heads have greatly aided in the lecture program.

Fish and game protection association meetings gave opportunity to discuss problems with sportsmen and service clubs furnished opportunity to meet business men.

During the spring of 1930, a course on the ''Aims, Methods and Materials of Nature Study'' was given a group of more than fifty school teachers in Oakland. The demand for this course evidently came as a result of intensive accomplishment by a school lecturer of the bureau a couple of years ago.

The director of the bureau represented the division at the American Game Conference at New York City, December, 1928, and again in December, 1929. At the same time, it was possible to attend meetings of the Committee on Educational Problems in National Parks.

Thousands of people were reached through broadcasts over the radio. A special Bird and Arbor Day program was given over radio KGO in March, 1929. During the fall of the same year, a series of broadcasts were given over KRE, participated in by several different employees of the division. Some presentations took the form of dialogues and others were informal talks.

Attendance Record of Lectures, Bureau of Education and Research, July 1, 1928, to June 30, 1930

Organization	*Number of Lectures*	*Attendance*
High schools	130	73,193
Grammar schools	53	18,325
Universities and colleges	17	2,895
Civic and public	47	6,448
Service clubs	75	4,464
Masonic and other lodges	38	4,240
Fish and Game Protective Association	55	7,499
Boy Scouts, Camp Fire Girls	7	702
Radio	12	-----
Miscellaneous	66	7,447
Totals	500	125,213

Letters of inquiry are many and an effort has been made to furnish the authors with dependable scientific information.

Summer Resort Educational Work. Participation in the educational program in Yosemite National Park was continued for the ninth and tenth seasons. The enlarged staff made possible the extension of the work to outlying stations and to the Yosemite Hatchery, where there was splendid opportunity to interest visitors in fish propagation. A new method of instruction was developed in the summer of 1929,

when a guide was placed in charge of a caravan of automobiles which stopped at the more interesting places to receive instruction.

The daily field trips offered form an important feature of summer educational work for here individual instruction is given and a direct personal contact made. How better can conservation be taught than to use a living individual of a species as a basis of discussion! The sight of a family of Sierra grouse makes a more lasting impression than word pictures or even photographic studies. A first-hand acquaintance with conditions in a game refuge is more stimulating than the reading of printed words in a book. Many teachers make use of this opportunity to obtain first-hand information regarding living things. As these teachers go back to their classes, conservation ideas are spread through the schools.

The Yosemite School of Field Natural History, a training school for students of field natural history and conservation, graduated two additional classes, the last one raising the number of graduates to close to the hundred mark. These graduates spread throughout the state develop interest in conservation of natural resources. A number become professional nature guides.

Educational work in California State Redwood Park continued each summer. Mr. J. B. Newell was forced to resign on account of ill health, and his place was filled by Harry Bauer. On the resignation of Emily Smith, who helped to inaugurate the work and carried it on most successfully for several years, Miss Nancy Yerkes was appointed.

Evening lectures dealing with fish and game conservation and daily field trips for both children and adults were offered with this staff of two guides. Twenty-seven thousand people made use of the service in two months.

During the summer of 1929, a stereopticon lantern was available and lantern slides were used. Furthermore, it was possible to show motion pictures, as a projector was rented and this greatly aided in giving visitors visual evidence of the magnitude of the state's natural resources in fish and game and in the conservation work accomplished by the division.

A series of field trips and lectures were given at Feather River resorts by Rodney Ellsworth during the month of July, 1929. This new work was received with enthusiasm and it is hoped that it can be continued.

The following is a summary of the number of lectures and field trips and the attendance:

Nature Guide Service, Yosemite National Park

	Field trips		*Lectures*	
	Number	*Attendance*	*Number*	*Attendance*
July–August, 1928	229	5,502	238	34,161
June–August, 1929	No record		No record	
June, 1930	No representative of Division present			

California State Redwood Park

	Field trips		*Lectures*	
	Number	*Attendance*	*Number*	*Attendance*
July–August, 1928	80	2,675	19	13,625
July–August, 1929	103	3,607	50	23,455
Totals	183	6,282	69	37,080

Boy Scout Training Camp. State conservation leaders have for some time sought effective means of better utilizing the Boy Scouts of America in the conservation program. Seeking a cooperative scheme, conferences between the Bureau of Education and Commissioner C. J. Carlson of the Boy Scouts resulted in plans for a conservation training camp for eagle scouts. Because of educational facilities furnished by the nature guide service at Yosemite, Yosemite Valley was chosen as the location for the camp. The cooperative scheme as worked out provided that the Division of Fish and Game would furnish transportation and instruction, and the Region XII Executive Committee, the camp direction. Each boy was to be chosen on the basis of interest and attainment and to stand a share of food expense. A prospectus of the camp was issued in June. Brighton C. Cain, naturalist of the Oakland Council, was chosen as camp director.

Twenty-nine advanced scouts, representing 18 different councils, arrived at camp, situated in Camp 8, Yosemite, on August 5. The oldest boys were just over 18, and the youngest, 15. They hailed from 27 different cities of the state.

Instruction began the second day. The boys were welcomed by J. S. Hunter of the division, and the objectives of the camp were outlined by him and Mr. Cain. The morning of each day was devoted to talks and discussion led by conservation leaders and by members of the staff of the Yosemite Nature Guide Service. D. D. McLean led the afternoon field trips. Park Naturalist Carl Russell gave an illustrated lecture on mammals. H. C. Bryant discussed conservation methods and ways in which Boy Scouts may help in game conservation. George Wright, former assistant park naturalist, told the boys of forestry problems. An all-day field trip was taken to Little Yosemite and a day-and-one-half trip to Glacier Point and along the Pohona Trail. First-hand acquaintance with deer, grouse, quail, and with conditions in a game refuge were the tangible results of these field trips. Various speakers contributed to campfire programs. Governor C. C. Young appeared at one of the campfires and thrilled the boys with a fine conservation talk.

The boys who attended this first conservation camp showed a fine, earnest spirit. Notebooks were kept busy. Discussion showed that they absorbed the fundamentals of conservation and were anxious to resolve them into action. It was quite evident to all those having contact with this training camp that the plan holds great possibilities. Boy Scout officials were pleased. Division of Fish and Game officials were more than satisfied.

The boys went home with real first-hand experience with game and with refuge conditions as well as with practical conservation ideas and methods. When they got home they spoke at service club luncheons, at fish and game protective association meetings, instituted clean-up campaigns, arranged conservation exhibits at schools and in bank windows; they became leaders in conservation matters in their troops and in their respective communities. No more fundamental educational program could have been inaugurated.

The boys who received the training were especially selected because of their interest. They were old enough to assimilate and utilize the

instruction given. They were stimulated to inaugurate worth while conservation work with their own troop and with their community. The influence for good which they will exert can not be measured.

Conventions. It has been the policy to make the annual spring convention of division employees educational in nature. As a consequence, it has been the duty of this bureau to provide suitable programs.

FIG. 24. Blind from which first photographic evidence was made of nesting of long-billed curlew in California, scene from "Shorebirds" 125–A.

A slight change in emphasis was made in 1930, when, instead of formal talks, subjects were simply presented by a chairman and were discussed from the floor. In each instance, a display of the more recent educational motion pictures was given.

VISUAL EDUCATION

Motion Pictures. During the biennium, it has been possible for official photographer E. S. Cheney to greatly increase the library of films. Fine new material allowed the making of new reels covering the following subjects: shorebirds, antelope, cranes, game refuges, commercial fisheries, Pismo clams, spiny lobster and striped bass fishing. For some time, need has been felt for a feature reel showing the activities of the division. This was finally completed in the spring of 1930. With a simple scenario it visualizes the wide activities in the interest of game conservation: law enforcement, fish propagation, game propagation, commercial fisheries, screens and ladders, education and research.

When an endeavor was made to furnish news reels for showing throughout the state, it was discovered that talking pictures are now in vogue and that silent pictures are not utilized on the larger circuits. As a consequence, a news reel on ducks and other game birds has been utilized in connection with lectures rather than released on a circuit.

The reels show birds and animals in their native haunts and the pictures are outstanding even though as yet they are not produced with sound. Some of the reels have been so favorably received at the American Game Conference, in New York City, that other reels have been requested each year.

Early in 1930, a complete list of films was prepared, indicating that there are now more than forty reels ready for loan. An attempt was then made to have them widely used in the schools. A little advertising brought splendid results and there were times when practicaly every usable reel was being utilized in some part of the state. In several instances, county agents have borrowed reels and have used them for a period of several weeks at various farm bureau meetings. A growing call comes from bureaus of visual instruction in city school departments. Here again, request is made for the use of a film for several weeks at a time in order that it may be shown in many different schools.

Storage of the films has been improved through the purchase of a power rewind and a new portable screen has improved projection.

The end of this fiscal year finds all negatives properly stored in sealed cans and practically all of the positive film utilized in reels suitable for loan.

Through the courtesy of the Dupont de Nemours Company, it was possible to secure a 16mm copy of the three-reel feature, ''From Hatch-

FIG. 25. Little brown cranes wintering in the San Joaquin Valley. Photograph by E. S. Cheney, May 24, 1929.

ery to Creel.'' A second set of this narrow film, owned by the Dupont Company, was also deposited in the office for use. There has been much call for these 16mm reels, the first the bureau has acquired. The Bureau of Visual Instruction, of San Francisco city schools, borrowed them in the spring of 1930 and showed them in most of the schools in

the city. It is expected that there will be sufficient demand in the future to warrant other reels being acquired, even though the policy is to emphasize the use of standard width film.

Lantern Slides. The collection of lantern slides was augmented by the purchase of about 20 slides from Mrs. W. Leon Dawson. Additional slides used for illustrating lectures on research problems and a few miscellaneous slides were also added.

FIG. 26. Exhibit displaying miniature of the Mt. Shasta Hatchery. Civic Auditorium, San Francisco, California, October, 1928.

New shipping boxes have greatly reduced breakage of lantern slides. Although the call for slides has not been great, it is felt that this service is worth while. If there were sufficient help to prepare slides for shipping, the number of loans could be very readily increased by advertising their availability.

Photographs. We are glad to report that the entire collection of photographs has been rearranged according to subject, and is in order. This has been accomplished through the kindness of Miss Selma Werner, who volunteered her services to bring the photograph file into perfect order. As a consequence, it has been possible to locate any

photograph desired, and there has been constant calls from newspapers, magazines and authors for the loan of photographs. In each instance, the borrower is requested to give due credit to the Division of Fish and Game.

Official Photographer E. S. Cheney has added many splendid 5 by 7 photographs of various game species, and also of various activities. Of particular interest is a splendid series depicting the commercial fishery industry. Some enlargements have been made from motion picture films which have added greatly to several subjects.

Exhibits. During the fall of 1928, two portable exhibits showing mountain sheep and the Mt. Shasta Hatchery were routed from one chamber of commerce to another. In the larger cities two weeks was allotted for display. In all sixteen cities utilized these exhibits as well as several county fairs. Favorable reports were made as to the interest taken by the public in viewing these exhibits. In recent months, both exhibits have been on display in the lobby of the headquarters office in San Francisco.

A spectacular exhibit was installed at the Pacific Southwest Exposition at Long Beach during July, 1928, in cooperation with the U. S. Forest Service. There was displayed in front of a beautifully painted background a pond filled with trout, and a number of pens containing pheasants from the State Game Farm. Many were the comments received as to the effectiveness of this display.

An exhibit was made at the Auto Show in 1929, in San Francisco, and a more pretentious one at the Pleasure Boat Exposition the same year. In the latter instance, the fine painted background utilized at

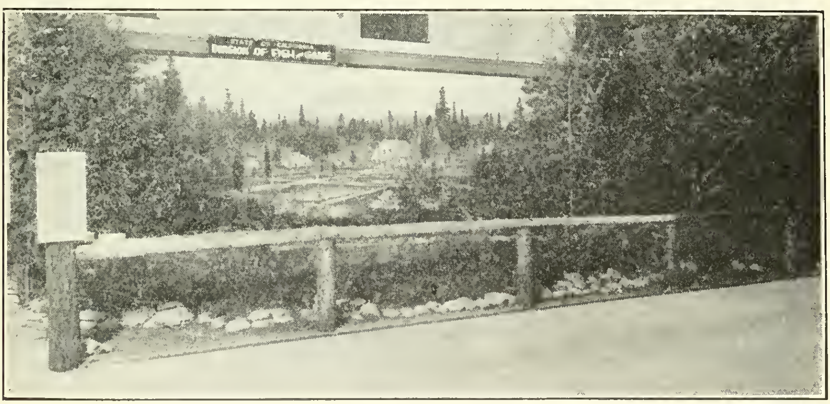


FIG. 27. Exhibit of brood pond system at the Mt. Shasta Hatchery. Civic Auditorium, San Francisco, April 27 to May 4, 1929.

the Pacific Southwest Exposition, at Long Beach, was used. A large tank gave a display of freshwater fishes, and pens exhibited birds from the game farm.

The study collection of birds has been widely used by employees and others. D. D. McLean has continually added to the collection and in time it will furnish a complete reference collection of all of the game

species and most of the nongame birds. Specimens useful in the identification of bones, teeth and hair have been accumulated.

LIBRARY

During the biennium, approximately 200 books have been added to the library, together with numerous pamphlets. Over 100 magazines and periodicals dealing with fish and game conservation are read by the librarian and routed to department heads each month. The library is suitably housed in a separate room and is arranged according to natural history subjects. Pamphlet cases contain miscellaneous bulletins and are catalogued accordingly.

It has been found that the use of the library by employees is increasing steadily. A particular attempt has been made to encourage deputies to secure books by mail, and this has met with partial success.

Sportsmen, school teachers and the public in general have made continuous use of the library's facilities, especially during the noon hour. The most popular subjects have been game farming, sport fishing and identification.

The policy is and has been to build up a good scientific and popular reference library pertaining to fish and game and related subjects. The need of this condensed, though creditable, natural history collection of books and pamphlets has been proved and the use of it shows that it is appreciated.

EDITORIAL AND PUBLICATIONS

The most potent medium of reaching the citizens of the state with reports of current activities continues to be that of a quarterly bulletin. In editorial policy *California Fish and Game* has maintained a stand on authenticity. The hunter's and fisherman's story finds no place, in that a dozen magazines carrying such stories are to be found on every news stand. The main articles are usually of a scientific nature, well illustrated with graphs and halftones, numerous editorials direct attention to the conservation of natural resources.

The fifteenth volume of *California Fish and Game* was completed in October, 1929. It contained 376 pages and 113 illustrations. No special numbers have been issued during the biennium, but the material published has been of high grade. The policy of running a column detailing various activities of the division appears to have been appreciated by readers. The edition now numbers 10,000, and well over 9000 copies are mailed each three months. There is continual evidence that the magazine is utilized regularly by schools and by all serious students of wild life conservation.

To encourage teachers to teach conservation is better than to try and cover all of the schools with a lecture program which does not have the continuity to be found in regular classroom teaching. A series of teachers' bulletins are issued designed to furnish proper teaching materials and stimulate the interest of teachers. One new bulletin has been added to the series entitled. "The Owls of California," by Donald D. McLean.

As a result of these activities, those who read have abundant opportunity to learn of conservation activities and are able to find dependable published information on the various fish, birds and mammals of the state.

Fish bulletins edited during the year number thirteen and of this number ten were completed by the printer and distributed; three are still in press.

A new game bulletin, the first to be published in a number of years, entitled "Quail of California," has been prepared by D. D. McLean, and has been sent to press.

Two leaflets have been issued, one on "The Care of Deer and Trout," and another one detailing Commission activities. The latter was prepared especially for use at the State Fair.

PUBLICITY

Beginning December 10, 1929, the publicity bureau was merged with the Bureau of Education and Research, and Leo K. Wilson was employed on a part-time basis to prepare press notices. The mailing

FIG. 28. An experimental pen of ducks on the Hollywood Duck Pond. Hollywood Gun Club, Kern County, California, 1928. Photograph by E. S. Cheney.

list for news items has been entirely remodeled. Two news items weekly have been issued and emphasis has been placed on various accomplishments and on statistical reports on fish and game. When Mr. Wilson was succeeded by Earl Soto, who is devoting full time to the work, the publicity releases were increased to nine a week.

A number of magazine articles have been prepared and published and plans are being laid to furnish feature materials. Numerous matters relating to public relations have been referred to this branch of the service.

RESEARCH

In that the attempt has been made to supply accurate information, not hearsay, the scientist has been called upon for solution of problems and for reports. Splendid cooperation has been secured from univer-

sities. Often a man has been employed on a part-time basis while working for a higher degree. Thus without cost have been furnished laboratory equipment and expert direction. The tangible results are evidenced by a series of technical bulletins and by practical accomplishments.

When research work was taken over November 20, 1928, the cooperative plan was continued whereby Dr. K. F. Meyer of the Hooper

Fig. 29. Banding sick ducks prior to placing them in recovery pen for observation. Hollywood Gun Club, Kern County, California. October, 1928. Photograph by E. S. Cheney

Foundation for Medical Research directs investigations relating to the disease of game and fish, and furnishes laboratory facilities.

Paul A. Shaw, with an assistant, has been endeavoring to find out the cause of duck disease. He has made numerous trips into the field, including Klamath Lake, Hollywood Gun Club, Kern County, Salton Sea, and Bear River marshes, Utah, gathering evidence. By means of numerous experiments on live birds he has been able to discount theories based on the idea that the disease is a contagious one caused by bacteria. Mud and water gathered at places where the disease occurs regularly and from places where the disease is not known, when analyzed gave information as to salts that might be concerned. The toxic effect of numerous chemicals has been tried out and it is believed that eventually it will be possible to produce the disease artificially in the laboratory. Three chemical papers giving the result of these studies have been published in the Proceedings of the Society for Experimental Biology and Medicine, under the general heading of "Duck Disease Studies:" 1. Blood Analyses in Diseased Birds; 2. Feeding of Single and Mixed Salts; 3. Salt Content of Soils in Disease and Nondisease Areas.

With the first reports of an outbreak of duck disease, Mr. Shaw will be in the field to check on laboratory findings. A full report on the investigation is being prepared.

Before leaving in the fall of 1928, Dr. Henry Van Roekel completed certain studies of the parasites of deer. Numerous post-mortem examinations of diseased game birds, mammals and fish were made and reports sent to those interested. Published articles have reported the main findings. Of particular value also were a number of tests which he conducted at the State Game Farm in order to prevent such dangerous diseases as coccidiosis, tuberculosis and blackhead. As a result of these studies he prepared a list of disease preventive measures to be employed by game breeders. It is believed that the suggestions for sanitation will aid in eliminating some of the troubles of the game breeder.

During a disease outbreak in one of the hatcheries, he developed a new method of controlling skin parasites of trout. A severe outbreak

Fig. 30. Deer lung infested with lung worms, *Dictyolcaulis hadweni*. Bronchioles are filled with worms. (Natural size.)

of furunculosis, that dangerous disease of hatchery trout, was successfully controlled.

Dr. E. C. ORoke completed his investigations of a type of bird malaria found in the valley quail. The quail fly, of the family *Hipoboscidae* was shown to be a carrier of the causative agent, a blood parasite, *Haemoproteus lophortyx*. In addition, Dr. O'Roke discovered a dangerous, contagious disease in quail secured on private game farms. Reports were received that quail were dying in numbers. When some

of these birds were secured and placed with healthy birds, the healthy birds quickly took the disease. The causative agent of this dangerous disease has not been discovered.

On the predatory animal is placed much of the blame for depletion of game. Whether this is entirely justified is not known. It seemed best, therefore, to try to find out more as to interrelations between the predator and the animal preyed upon. Mr. E. L. Sumner, Jr., of the University of California, was employed beginning January, 1930, to assemble data on the interrelations existing and the value or nonvalue

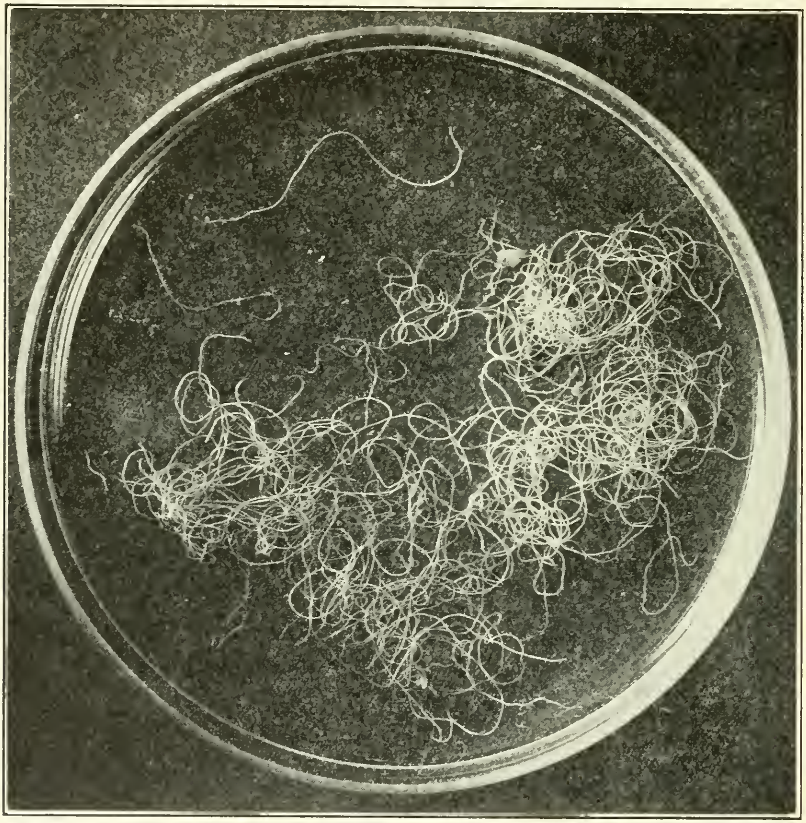


FIG. 31. *Capillaria contortum* removed from the crop lining of California valley quail. Slightly enlarged.

of such animals as the bobcat, coyote, weasel and other predators. Plans were immediately laid to carry on control experiments on similar plots of ground, on one of which predators are to be killed and on the other to have full sway. Censuses should indicate which is the best method to pursue. A book soon to be issued by the University of California treats of the fur-bearing animals of the state, and will furnish valuable data as to their food.

Another problem which has grown more and more serious with the years has to do with damage by deer. Deer appear to be increasing in

numbers and complaint became so heavy in the spring of 1930 from apple growers and vineyardists that it became necessary to employ someone to study the problem. Gordon True, Jr., a student at the University of California, has undertaken a study of damage together with studies of means of protecting crops. He has experimented with repellents of various forms, most of them employed in the form of a spray. A full report as to the outcome of experiments will be published.

Along with these economic studies, Mr. True will investigate the parasites of deer. A number of deer have been examined which showed infection with lungworm. This sort of infection appears to be on the increase and it is quite necessary that a scientific study be made of this and other diseases of deer.

Donald McLean completed a careful study of quail in San Mateo County. He followed certain flocks of quail throughout the year, taking censuses and following their seasonal movements. He actually discovered a number of baby quail dead on a cold, foggy morning. It may be that weather conditions have a great deal to do with the successful rearing of young birds. The findings of this study will be published in a forthcoming bulletin.

Mr. McLean's particular problem has been that of crop damage by birds. Three types of damage have received most study: bud cutting by small birds in Tulare County; blackbirds and mudhens in relation to rice; and band-tailed pigeons in relation to cherries. In addition, he has aided in field investigations relative to waterfowl refuges and duck disease.

Investigations of the present status and damage caused by elk have also been made. Better knowledge through other field investigations of the present status of the burro deer and mountain sheep has been secured.

In spite of the accomplishments reviewed the field is not adequately covered; a satisfactory continuing program in the schools has not been attained; the radio has possibilities not yet utilized; film distribution is not continuous and stabilized; the research staff has too many problems and too small a personnel for greatest effectiveness. A start has been made, a foundation laid, but the field is still undeveloped. The work is still too new; it is still in an experimental stage; contributions to the cause are few instead of many, for less than a dozen states support work of this kind. Trial and error methods, however, are bringing stabilization, and the future looks bright.

"Bringing an appreciation of the importance of conservation to the background of human consciousness is a work which can not be done by one man or one organization in one year, or by many men and many organizations in many years." Even though results may be incomplete and rather intangible at the present, there is nothing which builds more widely for the future than does an educational program. With an enlightened public sentiment, we progress; without it, we mark time.

REPORT OF THE BUREAU OF GAME FARMS

By August Bade, in charge

From a certain class of thinkers there has been opposition to any program of artificial propagation of game birds. This resistance has, probably from sentimental reasons, been directed more particularly against introduced species such as ring-necked pheasants and Hungarian partridges. One of the favorite arguments of the opposition was the danger of introducing disease among the native species. But with the importation of thousands of these exotic game birds, and no trouble having showed up in the last twenty-five years, this argument has died a natural death.

Likewise the argument that introduced species would drive native game birds from their natural habitat has fallen of its own weight. On any game farm it is a common sight to see California valley quail and ring-necked pheasants sharing the same pen. It is also common knowledge among game breeders that if there is any "bossing" it comes from the quail. Like other members of the partridge family these quail will stand on their own and do battle for their rights.

While all this resistance has been going on the opposition has not suggested a program that seems likely to make the life of the sportsmen more enjoyable. It has been more a question of talk and debate, with considerable legislation thrown in for good measure, while the native species have gradually faded from the picture. Sportsmen who are paying the bills and have a right to say how their money is to be spent are wondering what it is all about.

With the development of game farming along more or less practical and scientific lines sportsmen are seeing a little ray of sunshine ahead. In the past five or six years the idea has taken a firm hold and now nearly every state of the Union has one or more farms. Not only have the states and federal government taken a hand in the work, but individuals and organizations of men all over the country are taking a hand and have active programs of propagation work going on. Until something better is presented propagation work through the agency of the game farm will grow and develop.

The laboratory means as much to game bird farming as it has to other lines of industry. Scientific knowledge is being applied to feeds and general management in a way that has caused radical changes in the past few years. For a long time it was thought the domestic hen was a necessary factor in propagation. There is no doubt but the hen has played an important part but we believe she was merely a stepping stone to better things. While she has some excellent qualities, she at the same time presents problems that are hard to deal with both by the amateur as well as the experienced breeder. These good features are more than balanced by her faults.

DOMESTIC DISEASES

The domestic hen when used as a foster mother may bring any one of many diseases common to poultry that are fatal to game birds. In a

few cases it is possible to test hens before they are used as brood mothers, but this is seldom done because of the expense and the necessary knowledge. The tests for tuberculosis and diarrhea (B-W-D) are quite simple when you have the equipment. But there are many diseases like coccidiosis, extremely bad among young birds, for which there is no known test. Such hazards as lice and any kind of body vermin are simple to handle, but it is the invisible intestinal parasites that cause the great damage. Because of these disease hazards many game breeders are turning to artificial incubation and brooding.

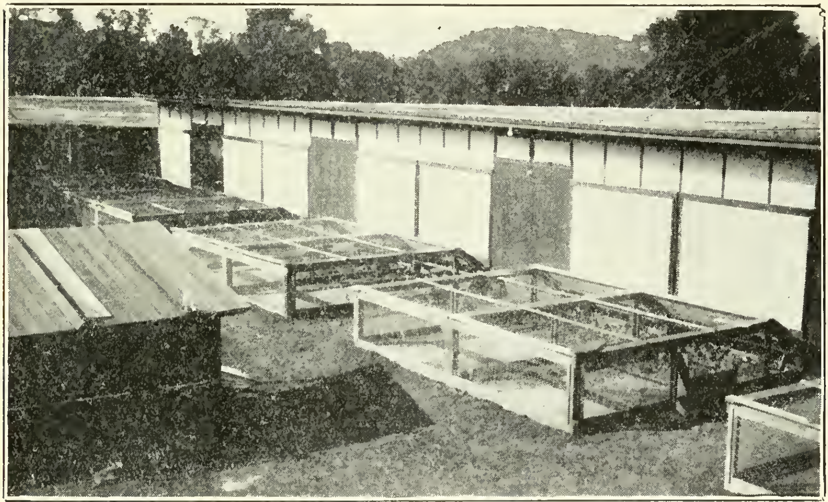


FIG. 32. A battery of 8 electric brooders in action at the Yountville Game Farm. These brooders are 8x12 feet with a 6x12 foot run for additional exercise room after the birds are a week old.

ARTIFICIAL INCUBATION AND BROODING

During the season of 1928 a start was made at the Yountville farm towards an electric program of brooding. Incubators had been used for a long time in hatching game bird eggs, but the attempts at artificial brooding had been anything but encouraging. In most cases it had proven a failure. However, with improved equipment and more knowledge of feeding, another trial was made. The equipment was first tested out on domestic poultry and then turkeys were tried, with excellent results. From turkeys we went to ring-necked pheasants, using practically the same methods as we did with turkeys, and the results were more than encouraging. With the start of the 1929 season we had built better brooding facilities and succeeded in brooding about 1500 pheasants and more turkeys.

Encouraged by the results of the two previous years our 1930 program included pheasants, turkeys, quail, and guinea fowl. All of these birds respond remarkably well to electric heat and the better feeding program. Judging from the results so far obtained artificial brooding is here to stay and will be incorporated into all game farm programs of the future.

The chief claim, then, for this newer system, is the elimination of the disease hazard and the better control of conditions under which birds are reared. With advanced knowledge of sanitation and the value of foods, rearing birds under this system becomes more a matter of detail. The operator has the confidence that he controls the situation.

Brooders may be built to suit the convenience of the operator. We think the best results are had when small units are used. Pheasants,

FIG. 33. Contra Costa sportsmen keeping plant pheasants in their locality. Photo by Bear Photo Service, January 6, 1930.

because of their individualistic traits, may be brooded in larger lots, while quail, belonging to the covey type of birds, seem to do better in families of from fifteen to twenty. In handling any kind of game bird it is well to take into consideration these individual characteristics.

DISTRIBUTION SYSTEM

Shortly after the Yountville farm was completed, and it was evident that a few thousand birds would be available for planting, it was decided that some systematic plan should be followed in their distribution. At that time, and the plan is still being used, it was determined that no small plants should be made of but a few pair of birds. It was also agreed that all areas in which birds were to be planted should first be surveyed by a competent person and the ground posted with signs of warning, if approved. Then from fifty to a hundred pairs of birds would be liberated in the area, the number depending on the size of the closed area. These areas were formed by the pooling of several ranches, and included from fifty to one hundred thousand acres. It was further agreed that subsequent plantings should be made until the area was sufficiently stocked.

GAME BIRD REFUGES

Our system of National Parks has demonstrated what a closed area means to bird and animal life. Where properly organized refuges are

maintained, so that the output of the game farm may increase according to natural habits, the influence of artificial propagation is made very effective. These sanctuaries not only become well populated with bird life but the overflow soon stocks the adjoining territory. If this system is carefully followed any state or given territory will soon become well stocked. This in a way is only helping nature in a scientific way. If bird and animal life is to be brought back it most certainly will be done in this way.

MANY SPECIES OF GAME BIRDS AVAILABLE

Judging from the interest shown by those who are familiar with the wild turkey there is no bird offering more sport or requiring more real skill for a successful bag. We are also advised that California has much natural territory well adapted to these birds. For these reasons we have made an effort to stock certain sections with the Mexican Bronze turkey, the species best suited to this type of country. In this effort to further the pleasure of the sportsmen we have received able assistance from Mr. George W. O'Connor, San Francisco, who made it possible to get the original wild stock from the state of Arizona as a foundation breeding stock. To those who may believe that the wild turkey is extinct we would invite their attention to the game laws and open seasons of about seventeen states out of the forty-eight. California might just as well be one of them.

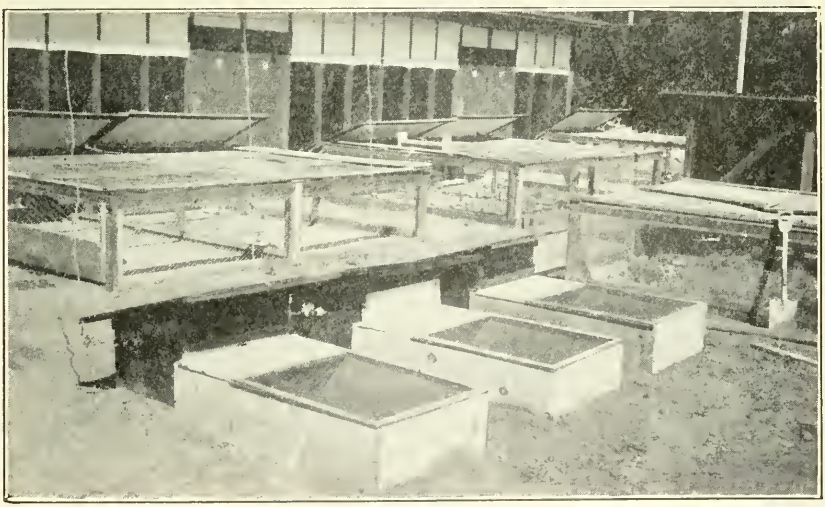


FIG. 34. The three small brooders are transformed field coops. An electric hover is substituted for the foster mother hen. These coops are 22x28 inches with a 5-foot screened-in run.

PARTRIDGES

The introduction of the Hungarian or grey partridge has met with such success in many states and Alberta that a long open season is permitted and the birds are increasing even in the face of an open season. Their natural reproduction, as checked in many places, is just double that of quail and pheasants. In Washington it was found that

they increased at the rate of sixteen for each pair while the average for quail and pheasants was eight.

Their natural habitat is the rolling hills and grain fields that was formerly the home of the native prairie chicken. On the wing they are a match for the speed and cunning of the bob white or California valley quail. Another feature of this bird is the fact that they do not congregate in numbers during the winter. The family, under the guidance of the two parents, remains as a family until the mating season.

FIG. 35. Hungarian partridges being received at the Yountville Game Farm direct from Europe.

The Chukor is another partridge, native of India, that has proven his worth as a game bird. They differ from the Hungarian in that they may be produced on a game farm in numbers like quail or pheasants. They seem to thrive under domestic conditions and yet it does not break down any of their natural instincts as a game bird. Attempts at breeding the Hungarian under domestic conditions have invariably met with defeat.

The bamboo partridge, native of Asia, as its name suggests, lives in the cane or bamboo thickets. But it has been found that willow thickets appeal to the bird and they make themselves at home when transplanted into this sort of cover. They are fast, but not as liberal in production as the Hungarian or Chukor. The average nest contains about seven eggs.

The Division of Fish and Game has inaugurated a systematic plan of importing a certain number of partridges each year for a period of five years. These birds will be released in suitable cover and given the best possible protection. It is planned to produce the Chukor on our game farms.

CALIFORNIA VALLEY QUAIL

The natural stock of this fine game bird is still sufficient, but needs a lot of real help. In some sections they are more than plentiful. Trapping from the over-populated areas will help a lot and these birds can

be transferred to uninhabited areas. The move to create refuges for them is a real forward step, and our program to increase the breeding stock on the game farms on an even basis with pheasants, will give them added strength. There is no finer game bird to be found any place and he deserves all the help and protection that it is possible to give him.

THE REEVES PHEASANT

In the general scheme of nature bird life is well distributed, each species having its own habitat. In the pheasant family you will find the ring-neck, Mongolian, and versicolor only in the low lands. They like the cultivated fields and marsh land. The Reeves pheasant ranges from three to six thousand feet, and it is impossible to keep him in the lower regions. He is one of the true pheasants, with much to offer for the entertainment of the sportsman. As matters now stand there is little bird life in the higher altitudes. This fellow, with his tail of five or six feet and beautiful black and gold color, would add to the beauty of the mountain scenery. We have sufficient stock at both farms now so that we will be able to raise and liberate many of these fine game birds this coming year.

ADDITIONAL FARMS

On December 8, 1929, the Los Serranos game farm was dedicated under the joint supervision of the Division of Fish and Game, Izaak

FIG. 36. The original stock of wild turkeys, Mexican Bronze, from the White Mountains of Arizona. These fine birds produce 200 young turkeys the first year.

Walton League, and the Associated Sportsmen. Eight thousand sportsmen and their friends joined in the program. This farm is built entirely of steel and marks a new departure in game farm construction. It will serve the southern part of the state and make the work of distribution simpler. As funds are available more farms will be built in locations yet to be selected. The plan is to locate these farms in the center of the area to be served. Competent authorities tell us that

California will need at least four farms to care for present needs, to say nothing of the future.

FUTURE PROGRAMS

It is, and will continue to be, the policy of the Bureau of Game Farms to seek out the particular type of game birds that will add to the pleasure of the sportsmen and help to make the outdoors attractive to all classes of individuals. We are not so much interested in what particular part of the world the birds come from, but what they are worth to the sportsmen of this state. We are willing to let time and experience settle the problem of the particular type.

And in the meantime let native game birds enjoy the protection of game sanctuaries as numerous and extensive as can be afforded, but on those parts of our domain where public shooting is practiced and its continuance is desired, the practical necessities of the situation require the use of species of game birds that will produce the best results and be produced in numbers by artificial propagation.

	Eggs laid	Eggs distributed for hatching	Birds planted	Birds purchased	Eggs purchased	Birds on hand	Birds donated
Ringnecked pheasant	53,583	6,367	14,935		2,200	8,930	
Valley quail	2,737		684			862	84
Partridges			1,534	1,710		85	
Wild turckeys	1,195	140	358			346	7
Golden pheasant	363	30	83			64	
Silver pheasant	324	50	120			66	2
Reeves	282		33			84	

FIG. 37. Chart showing production in eggs and birds for the past two seasons.

REPORT OF BUREAU OF GAME REFUGES

By J. S. Hunter, in charge

GAME REFUGES

California has set aside by legislative act 39 game refuges. These sanctuaries have an area of over two and one-half million acres. They were created under the authority conferred upon the legislature by article 4, section 25½, of the state constitution adopted by initiative in 1902. This amendment authorized the legislature to divide the state into fish and game districts and to adopt such legislation as was deemed appropriate. Under this authority the legislature has set aside from time to time certain areas upon which it was deemed appropriate to prohibit all game hunting.

The first of these areas was set aside by the legislature of 1915. At that time refuges were created in Trinity, Santa Cruz, San Benito, Los Angeles, San Bernardino and Orange counties, and at every session since 1915 additional areas have been created, located in 28 different counties. At the last session of the state legislature there were set aside:

Designation	*County*	*Area in Acres*
1R	Tuolumne	96,640
1S	Lassen	14,720
1T	Humboldt	1,920
3H	Santa Barbara	17,920
General Grant	Fresno	17,280
Bolinas Quail Refuge	Marin	800

The first four refuges were created at the request of sportsmen of the various counties interested.

General Grant Refuge surrounds the national park of the same name. This park comprises an area of only 2536 acres. During the hunting season, hunters in the area adjacent to the park endanger the lives of anyone who may be in the park. It was deemed wise to keep hunters at a considerable distance from the park boundary for the safety of the thousands of park visitors.

The Bolinas Quail Refuge was created at the request of owners of the land within its boundary.

In practically every instance before an area is set aside, local interests have been given consideration and the need and advisability of a refuge considered from every angle. The U. S. Forest Service is of great assistance in this work.

Every year there is more and more demand for additional closed areas, so much so that we must consider the rights of the hunter. Already there are many parts of the state where the unattached hunter has difficulty in finding open country in which to hunt. It must be remembered that for every area that is removed from the hunting field, the hunters that were accustomed to hunt that area are forced to find new grounds and as a consequence congest conditions that much more in areas still open.

The increase in the population of the state each year brings added difficulties. In southern California hunting conditions and regulations are becoming more and more of a problem. Twenty years ago the population of the six southern counties was 705,225. Today it is 2,804,444; more by 426,895 than the entire state population of twenty years ago. In the six southern counties since 1880 the population has increased from one person to 511 acres, to one person for every nine acres.

FIG. 38. Mallard with her ducklings in a pond on the state waterfowl game refuge near Los Banos. Photo by E. S. Cheney, May, 1930.

To merely close an area to hunting and not provide adequate provisions for enforcement of the law is poor conservation and unfair to the law-abiding sportsmen. All refuges have been carefully posted on nearly 2000 miles of boundary, but the best of signs become obliterated in time and, unfortunately, sometimes are torn down by careless hunters.

A resident guardian should be placed on each refuge. The duties of such a guardian would be to see that the purposes for which the area is set aside are carried out. A control of all factors that have any effect on the increase of game is necessary. The guardian must be well informed and capable of correctly interpreting all facts that are gathered from observation carried on throughout the year.

The first area purchased under the provisions of the new hunting license act that provided for the setting aside of one-third of the amount received for hunting licenses, was taken over at the beginning of the duck season on October 1, 1929. This refuge is located about four miles northeast of the city of Los Banos, in Merced County, in the

middle of the long famous San Joaquin Valley duck center. Its 3000 acres are crossed by Mud Slough that carries a fair flow of water at all times of the year. Outside of the water in this slough, there was no water on the property when it was acquired. By the end of the season, however, nearly 1000 acres had been covered. This was done notwithstanding the fact that there was a great scarcity of water on the west side of the San Joaquin Valley, and no rain until about the first of the year. This area is very well located and includes within its boundaries a series of three sinks known to hunters as the Buttonwillow lakes. In these sinks a depth of water up to 10 feet can be secured on an area of nearly 200 acres. Under the water rights purchased with the property, water can be secured, except when needed for agriculture, which will be during the hot summer months. In order to hold water on the refuge, it is necessary to have a depth that will take care of the heavy summer evaporation of approximately three feet.

On this area it will be possible to produce a considerable amount of natural food. Unfortunately, the entire Los Banos area has been heavily grazed during the past series of dry years and naturally feed is short. It is believed, however, that by not pasturing for a period of three or four years that natural cover will come back and it will not be necessary to plant heavily with introduced duck foods.

Fig. 39. Jay C. Bruce, state lion hunter, with a lion kill, decorating his fully equipped automobile. Lion Hunter Bruce, although handicapped with the loss of one eye, is after lions again.

On this area, and on all other areas that will be purchased, it is our intention to do everything possible to improve duck conditions. It is believed that in so doing we will improve the duck situation and provide a constant crop that can be harvested without unduly damaging the natural supply. The advisory committee that was provided for by the hunting license act, has under consideration refuge areas in various

parts of the state and will make numerous recommendations to the Commission during the coming year.

PREDATORY ANIMAL CONTROL

It has been said that our game refuges were becoming breeding places for various species of predatory animals, particularly wildcats and coyotes. It has been our practice during the trapping season to issue permits to properly vouched-for trappers to trap in practically all the refuges. Reports from such trappers in most instances, have not shown an excessive abundance of predators. The heaviest catch of coyotes was in a refuge in Lassen County, where one coyote per square mile was taken.

During the year 1928, at the suggestion of a sportsmen's organization, arrangements were made with the predatory animal division of the State Department of Agriculture, to place three of their most experienced trappers in refuges that were said to be particularly infested with coyotes and wildcats. Our division was to bear all expenses of such work. These trappers were employed during the late spring and summer months—a total of 287-man days. The following tabulation will show the result of their work:

Refuge	*Location (county)*	*Area sq. mi.*	*Coyotes killed*	*Wildcats killed*	*Days trapped*
1–I	Placer	140	10	0	38
1J	Amador	88	21	0	38
1–O	El Dorado	118	6	0	45
2A	Lake	60	9	1	42
3E	Santa Clara	6	7	6	74
3F	Contra Costa	16	0	0	13
			53	7	287

It should be mentioned that the seven coyotes and six wildcats credited to the refuge in Santa Clara County were not actually taken on the refuge but in the surrounding country as far as five miles from the refuge. Trapping on the refuges produced no predators and very few signs of predators were found. The total catch of 53 coyotes and 7 wildcats cost $1,565.21, or an average of $26.08 per animal. From the information gathered in this work, it was not believed that there was an excessive number of either species of predators on the refuges. The results obtained were not considered commensurate with the cost.

Predatory animal control is receiving a great deal of attention in California. Information recently secured brings out the fact that 43 of the 58 counties either pay bounty or contribute to state and federal agencies in charge of predatory animal control. There was contributed by counties $52,000 during the year and paid out in wildcat and coyote bounty $45,104, and on mountain lions $6,320. In addition the Division of Fish and Game paid approximately $15,000 in mountain lion bounty and control. To this nearly $119,000 must be added, which is the amount of state and federal funds used under the direction of the Federal Bureau of Biological Survey. Then to this entire amount must be added the hundreds of thousands of dollars received annually by trappers for their catch of pelts taken from predatory animals.

The U. S. Department of Agriculture Farm Bulletin No. 1618, a compilation of the trapping and bounty laws of the states of the Union, gives some very interesting information regarding payment of bounty and protection of fur-bearers throughout the United States. There are

bounties paid by state agencies in 22 states; 11 pay on wolves; 8 on mountain lions; 8 on coyotes; 11 on wildcats; 5 on foxes; 2 on weasel; 3 on bear; 3 on hair seal, and 5 pay on certain species of hawks. There are also bounties paid on a few additional species that are of little consequence. It is interesting to note that no state pays a bounty on raccoons, skunks or opossum. On the contrary, most states protect these species by a closed season. Foxes are protected in about one-half of the states.

Pennsylvania, the most frequently mentioned when the predatory animal question arises, at the present time pays a bounty on only three species of mammals—wildcats, gray foxes and weasels. Pennsylvania protects by a closed season raccoons, skunks and opossum. Pennsyl-

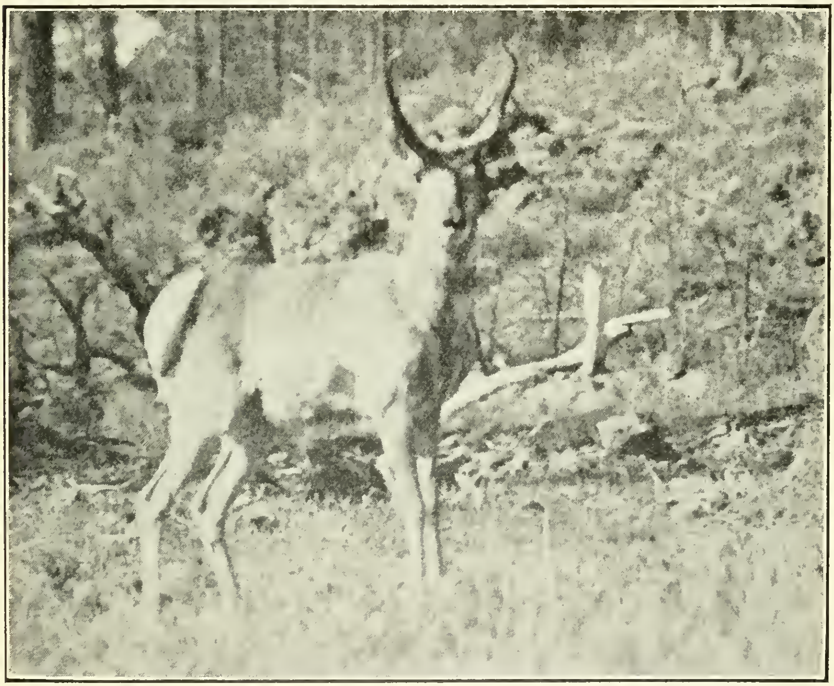


FIG. 40. Rarest of big game species. Prong-horned antelope. Photo by E. S. Cheney, May, 1929.

vania has been paying a bounty on certain species since 1915. The following tabulation is made from the reports for a period of 12 years.

	Wildcat	*Gray fox*	*Red fox*	*Weasel*	*Amt. paid*
Number killed	5,318	74,263	50,134	517,165	$1,053,226
Average per year	433	6,190	4,178	43,097	87,769
Killed in 1928	416	9,980	6,046	63,610	121,860

It will be noted that the 1928 kill of wildcats is almost as great as the average annual kill for the twelve-year period, and the kill of the other three species has increased approximately 50 per cent over the average annual kill for the twelve years. The question naturally arises if after the payment of bounty for twelve years the supply has increased, how long will it be before they are controlled?

The California Division of Fish and Game has been paying bounty for the killing of mountain lions since the inception of the hunting license act in 1907. Up to the end of December, 1929, bounty has been paid on 5811 lions, or an average of 257 per year. In 1929 a total of 309 lions were taken. The increase is partially due to the fact that we have employed additional lion hunters who have spent all their time in hunting, and also to the fact that extraordinary effort was made by local authorities to get rid of lions in the southern part of the state.

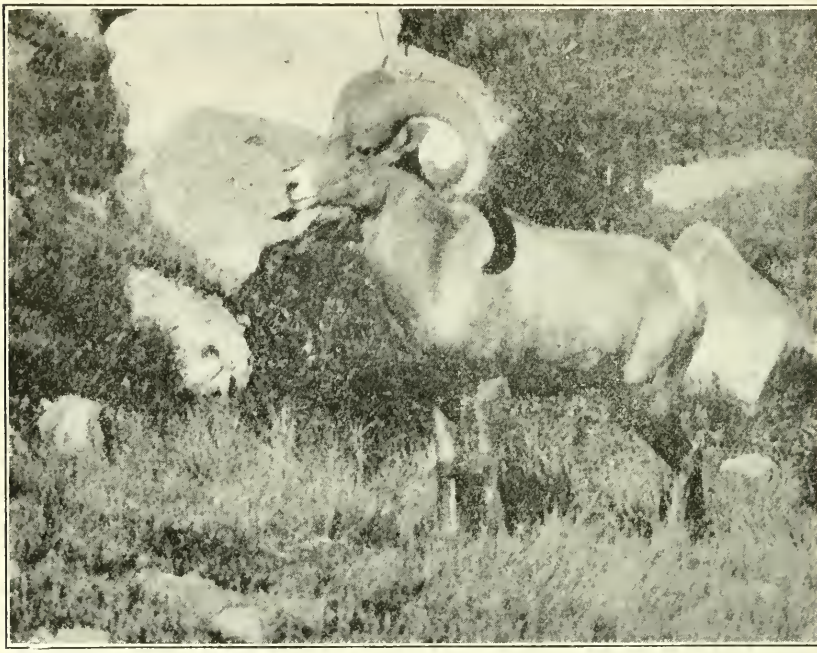


FIG. 41. Average sized desert mountain sheep ram, Inyo Range, Inyo County, California. Enlargements from moving pictures by E. S. Cheney, October, 1929.

The present good condition of the deer situation is due to our mountain lion work and also to our spike buck and generally satisfactory deer season law. The mountain lion is the one predatory animal that works almost exclusively on animals that are a benefit to man. Deer are their natural feed. Practically all other species of predators compensate for the damage they may do by being of use in the destruction of species that are in themselves harmful. Very little good can be said of lions. For over twelve years we have paid a bounty of $30 on females and $20 on males. During that time we have secured data that shows that the sexes are practically equal in numbers and it would be well to pay the same amount of bounty on either sex.

Predatory animal control is a subject that must be kept in mind by conservationists. Whenever predators increase to such an extent that they do more harm than good, steps must be taken to reduce their numbers. Before it can be certain that this condition has arisen, careful study must be made of the relationship of the various species one

to another, otherwise a situation may be brought about that can not be corrected.

DEER TAG LICENSE

The deer tag license law has been in effect for three seasons and has not only brought in a considerable revenue, but has given us much valuable information regarding deer conditions in our state. From an analysis of the data secured it would seem that even though there is a heavy annual toll taken by hunters each year, the deer in general are better than holding their own.

In a recent report of the U. S. Forest Service an estimate of the number of deer in the national forests of the country was made. The total for all the forests was given at 748,003. To the national forests of California were credited 245,000. Thirty-three per cent of the deer in the national forests of this country are in California, and the national forests in California include only about one-half of the deer country. During the past three years there has been practically no change in the size of the deer taken. The percentage of well antlered deer during the three-year period has held the same as will be shown by the following table:

	1927	*1928*	*1929*
Two points	46%	47%	46%
Three points	29%	30%	30%
Four to nine points	24%	23%	24%

Fig. 42. Young ram, three ewes and a small ram drinking at a spring, Inyo County, California. Enlargements from moving pictures by E. S. Cheney, October, 1929.

Approximately one-half of the deer is killed by residents of the county where killed. The other half is taken by visiting hunters. Los Angeles hunters killed deer in 48 counties, and San Francisco and Oakland hunters in 49. Most Los Angeles hunters do not go north of

Madera County. A few hunt in the upper coast counties and a greater number in the mule deer section in the northeastern part of the state. Few San Francisco and Oakland hunters find their deer to the south of Madera County. Most of them hunt to the north. Modoc County furnished deer to residents of 51 of the 58 California counties. Sacramento and San Francisco were the only counties in which no deer were taken last year. San Francisco is the only county where no deer have been killed during the past three years. Los Angeles County supplied the surprisingly large number of 691 deer in 1929. This is remarkable when it is considered that there is a very limited hunting area and the population of the county is well over 2,000,000. Apparently deer are even increasing in Los Angeles County.

As a trade stimulant deer in California are a wonderful success. Los Angeles hunters killed 2199 deer and San Francisco and Oakland hunters 2048. These were taken in nearly every county. Every deer represents several hundred miles of travel; probably on an average of not less than 300 miles, and to this add the travel by unsuccessful hunters and the grand total will be millions of miles.

In California there were issued in 1929, 115,472 deer tag licenses, there were killed 21,222 deer. On the average, one hunter in a little better than five secured a deer. There are without doubt thousands of hunters who do not have a chance to hunt and many others that do very little hunting, but even with the low average our kill is much better than that in New York state, where 77,735 licenses were issued with a kill of 6620 deer—an average of one deer to practically twelve hunters.

There is still a great deal of information that we do not have regarding the range of the different species and subspecies of deer in California. It is essential that this information be secured. Judging from present conditions, our laws relating to deer are very satisfactory but with additional information it might be possible to improve them.

ELK

A solution of the elk problem in California has not yet been reached. From a nature lover's point of view, we are fortunate in having three species of elk. From the standpoint of the agriculturists in the sections of the state frequented by these animals, we are not so fortunate. California elk still range in the Buttonwillow section of Kern County in numbers estimated approximately 400 head. During the past year it was necessary to employ a ranger to keep them from damaging growing crops. Another band of this species is the cause of some complaint in Yolo County. This herd of not less than 75 is the result of a transfer of animals that were first moved to Monterey County from Kern County and later taken to the Swanston property in Yolo County. A change in the ownership of the land upon which they ranged has made it necessary that some action be taken regarding their future.

The herd of Roosevelt elk in Humboldt and Del Norte counties numbering approximately 150 head, have caused considerable complaint from ranchers near Orick. This herd ranges for the greater part of the year in that section between the Redwood highway and the coast and between Redwood Creek and the north line of Humboldt County.

The Jackson Hole elk so far have caused no complaint. These animals range in the mountains of eastern Shasta County. This herd of a

few hundred head is the result of a shipment of elk secured by the Hon. C. C. McCray of Redding from the government when the surplus of Jackson Hole elk were being relocated.

It is unthinkable that the herds of California elk should not be perpetuated, but it is also unthinkable that they should be allowed to cause great damage to small ranchers. The time has come when some definite action must be taken by the state to provide refuges where these elk can be placed under fences and properly taken care of.

REPORT OF THE BUREAU OF COMMERCIAL FISHERIES

By N. B. Scofield, in charge

California's commercial fisheries have continued their remarkable growth during the past biennial period. The data of the commercial fisheries are segregated and published by this bureau by calendar years, as that method best fits the fishing seasons. The data, therefore, given in this report are given in calendar years, except where otherwise stated.

In the year 1928, the catch of all varieties of fish in state waters and off the coast of the state was 517,746,166 pounds. The catch of shellfish in these waters for the same year was 10,734,878 pounds, making a total of 528,481,044 pounds. In addition to this, California fishermen caught off the coast of Mexico, in both territorial and extraterritorial waters, 49,044,875 pounds of fish; and from the same waters there were brought in 726,408 pounds of shellfish, caught jointly by California and Mexican fishermen. The total amount of fresh fish and shellfish caught in the state and brought into the state during the year was 578,252,327 pounds.

For the year 1929, the fish caught in the state and off our coast was 770,518,114 pounds, while the shellfish from the same waters was 14,221,272 pounds, making a total of 784,739,386 pounds. The fresh fish and shellfish brought into the state from south of the international boundary add 65,015,497 pounds to the above figure, making a total of 849,754,883 pounds.

The fish and shellfish caught and landed in the state from the above sources represent an increase over the previous two-year period of 62 per cent.

We have not included in the total catch figures the shipments of albacore from Japan and Hawaii, salmon from Oregon and Washington, "totuava," or sea bass, from the Gulf of California or the catch of whales by companies operating out of California ports. There is also a considerable tonnage of seaweed and kelp taken in California waters which is not included.

The sardine fishery is by far the largest and most important in California. The total amount of these fish landed in the two years of 1928 and 1929 was 1,072,041,569 pounds, which is an increase of 70.4 per cent over the two preceding years.

California's fisheries are not only remarkable for their size but for their diversity. There are more than sixty different categories of fish and shellfish landed in California, and a number of the categories are made up of several species. The list is continually being added to, as the fisheries are being extended farther and farther south of the international line.

The Bureau of Commercial Fisheries publishes quarterly the amount of each kind of fish landed in the state. Beginning with the year 1926 we have been issuing yearly circulars entitled "Statistical Report on Fresh and Canned Fishery Products."

We are also publishing yearly fish catch bulletins which give the catch of each species in each locality by months, as well as special articles giving the important developments of the different fisheries as compared with past years. These are shown graphically and in condensed form wherever that can be done, to bring out the important features.

Statistical Circular No. 3, for the year 1928, shows the amount of each different kind of fish landed during that year at the different fishing centers. It shows also that the number of fish packing and canning plants in the state, exclusive of the fresh fish plants, was 68, valued at $9,427,886, and employed 6709 persons; 4,431,498 cases of canned fish were packed; 27,865 tons of fish meal and 3,749,302 gallons of fish oil were produced. The value of these products was $24,578,856. This last figure does not include the value of the fish handled by the fresh fish markets.

Statistical Circular No. 4, for the year 1929, shows there were 77 fish packing plants, valued at $9,677,107, and employed 7688 persons, which operated with an output of 6,022,568 cases of canned fish, 42,821 tons of fish meal, 6,548,126 gallons of fish oil and other products, valued at $30,401,499. If we add to this the value of the fresh fish products, we have a figure near $35,000,000.

In 1928, the number of commercial fishermen licensed was 5340. In the year 1929, the number of licenses sold was 6014. The increase in the number of fishermen is not so great as the increase in the amount of fish caught. This does not necessarily mean that fish are becoming more abundant in California. Larger and more efficient boats are being employed in the fisheries and, for that reason, the catches are larger. Most of the increase was in the catch of sardines. This increase was caused mainly by sardine canners placing higher limits on the fishing boats, which was the result of the change in the law permitting the canner to put a larger per cent of the sardines in reduction plants.

The most important developments in the fisheries of California during the past two years have been: The great increase in the sardine fishery; the sudden development of a very large mackerel canning industry; and the extension of fishing to distant and foreign waters to supply the increased demand which can not be supplied by our local waters.

SARDINES

The sardine fishery is by far the largest and most important fishing industry in the state. The great increase in the total amount of fish caught in the state is almost entirely due to the increase in the catch of sardines. This is clearly shown in Fig. 50, which gives the catch by calendar years. The sardine season, however, begins in the fall and ends the following spring, and it is customary for the industry to speak of the sardine pack and catch by seasons.

The amount of sardines caught and the amount of sardine products packed by seasons can be found in detail in the fisheries statistical circulars issued by this bureau, which are reproduced in the appendix hereto. To give some idea of the great size of the sardine industry, it is sufficient to state that in the season 1928–29 the sardine catch was 252,433 tons; there were produced from this great catch: 2,673,063 cases of 1-lb. oval cans and 313,044 cases of other size cans; 28,724 tons

of fish meal and 5,125,251 gallons of sardine oil. In the season 1929–30, there were caught 322,600 tons of sardines, from which were produced 3,514,210 cases of 1-lb. oval cans and 642,211 cases of other size cans; 35,462 tons of fish meal and 6,359,777 gallons of oil.

Although the amount of sardines caught has been increasing each season, the catch has not increased in proportion to the fishing effort expended, and there is every indication that the waters adjacent to the fishing ports have reached their limit of production and are already entering the first stages of depletion. The increase in the amount of sardines caught is the result of fishing farther from port with larger boats and improved fishing gear. This overtaxing of the supply of sardines is all the more regrettable when it is realized that the canners

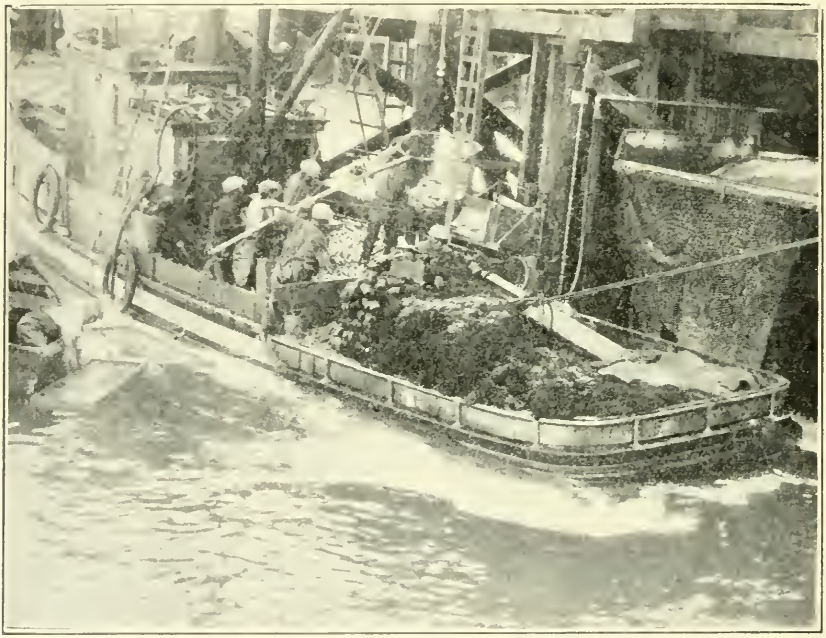


FIG. 43. Unloading sardines at the California Packing Plant, Terminal Island. Photo by D. H. Fry, Jr., March 11, 1929.

are not reaping the benefit. There has been an overproduction of canned sardines, as well as of sardine oil, and the old evil of selling canned sardines at less than the cost of production has continued, with the expectation of making up the loss with the profits from the sale of so-called byproducts—oil and meal. With this year's slump in the oil and meal market, this hope has not been realized, and it is now being proposed to reduce the price paid to fishermen from $11 to $8 per ton, in order that the canneries may continue to operate the coming season. The canners are also seeking, through organization, to limit the sardine pack and thus prevent overproduction.

The Fish and Game Commission has consistently endeavored, through legislation and through cooperation with the canners, to restrict the amount of sardines which canners are permitted to use in their reduc-

tion plants, with the belief that the canning of sardines is the highest use to which they can be put and that the excessive use of these fish in reduction plants would, in time, result in depletion of the source of supply. The majority of the canners, on the other hand, have sought to get the quick returns from sardine reduction and have made themselves believe there was no danger of depletion.

The following is a good statement of the situation in the California sardine industry, by Harry R. Beard, chief technologist of the United States Bureau of Fisheries, in Bureau of Fisheries Document No. 1020:

> Canning practically has been secondary in importance to the manufacture of fish oil and fish meal from whole fish and cannery offal. The state law never has required the canners to pack all the fish they have taken. The liberal excess that has been allowed has been taken advantage of for the manufacture of these products. Inasmuch as there is more profit in the manufacture of fish meal and oil than in sardine canning, every effort has been made to expand this branch of the industry. To do this it has been necessary, in order to comply with the state law, to can more fish. To get rid of this canned fish, the price has been lowered—low enought, in fact, to stimulate a large foreign demand, especially in the Orient, for pound-oval sardines. In some places this product has supplanted the cheaper grades of canned salmon; in fact, in 1925, for the first time, exports of canned sardines exceeded canned salmon exports.
>
> Whatever advantages or disadvantages the policy discussed above may have in the long run, it has brought about large scale production and a wide distribution of California pound-oval sardines. Adjustments are bound to come in the future, which will have their effect on the industry.
>
> In time, pound-oval sardines must sell at a price that is based on their own cost of production. Production of fish oil and fish meal can not continue to dominate canning.

Mr. Beard's prophecy has not yet been fulfilled but there is every indication that it is about to be fulfilled. Most of the canners now believe our sardine supply is being overtaxed and that the amount used in reduction plants should be reduced to the unavoidable minimum in connection with canning operations. Nearly all of the canners are in favor of limiting the pack by longer closed seasons or by any other practical means, and, at the same time, of improving the quality of the pack. In other words, they are for making the canning of sardines the profitable end of their business rather than rely on sardine reduction for their profits. It is easy to see how greater profits may be made from canning rather than reduction, provided a fair price may be obtained for the canned product. They now propose to get this fair price by improving the quality and at the same time avoiding overproduction.

LEGISLATION

In our last report we told of the uncertainty and ambiguity of the sardine conservation act of 1925, especially that part of the act which permitted canners to use an amount of sardines in reduction plants up to 25 per cent of the cannery's capacity, and of how we failed to reach an agreement with the industry and the bill designed to make the law more definite was withdrawn.

The 1927–28 season passed without any serious differences between the industry and the Fish and Game Commission, although, economically, the situation was becoming rather desperate for the canners, due to overproduction of canned goods.

One of the first acts of the newly formed Sardine Canners Association was to request the Fish and Game Commission to order a closed season on sardines, so as to prevent the opening of the 1928–29 season before August 6th. While this was done as a conservation measure, the main object of the request was to enable canners to dispose of their carry-over stock before the opening of the new season.

After the beginning of the 1928–29 season, the canners sought, in a further effort to curtail the canned pack, to induce the Commission to

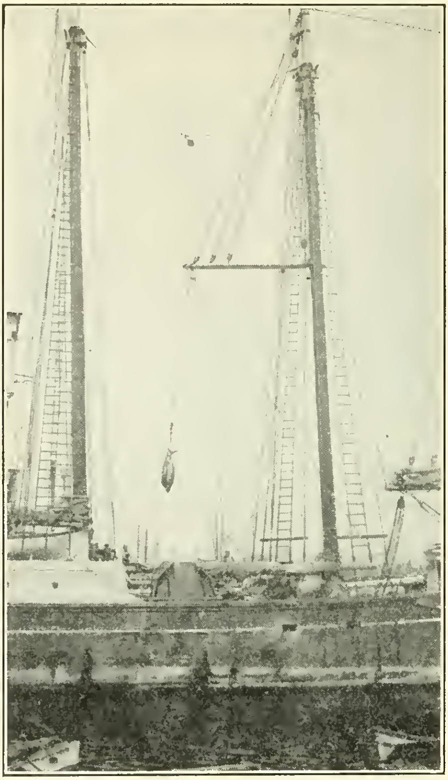


FIG. 44. Unloading sardines at the California Pack Plant, Terminal Island. Photo by D. H. Fry, Jr., March 11, 1929.

reduce the requirement of 15 cases from each ton of sardines received, to a requirement of only 12 cases. They argued that by so doing the canners would receive less fish and would pack a reduced amount of sardines, for which they would get a better price. They pointed out the fact that the law was indefinite as to what "capacity" is, and that the Commission could consistently make the requirements 12 cases per ton just as well as 15 cases. It was urged as a conservation measure. It was called to the Commission's attention that canners were permitted, under the law, to use fish offal in their reduction plants and, as the term "offal" was not defined in the law, the dictionary meaning

of the term would hold and that, under that definition, a canner could use any fish in his reduction plant, in excess of the 25 per cent, which were of a size or condition which the canner considered undesirable for canning. The Commission decided not to comply with this request.

The Monterey season had been under way about a month when the canners agreed among themselves that they would all pack 12 cases per ton—no more or no less. Not all of the canners held to this agreement when it was seen that the Commission intended to take legal action to close the plants under the abatement provision. Others agreed to make up the amount of pack they were short, if given time. When some of the canners failed to make up their pack at Monterey, abatement proceedings were started in the superior court of Monterey county but, at the request of Judge Jorgensen, the case was heard before Judge J. R. Welch, superior judge of Santa Clara County. The result of this case was a victory for the Commission.

Before the cases against the Monterey canners were finished, the sardine season had started at San Pedro and, as some of the canners at that port failed to pack as much as 15 cases per ton, abatement action was started in the Los Angeles County superior court before Judge Clair Tappaan. This case resulted in a decided victory for the canners. Under Judge Tappaan's decision as to the meaning of the term "fish offal" and as to what is 25 per cent of the capacity of a cannery, there

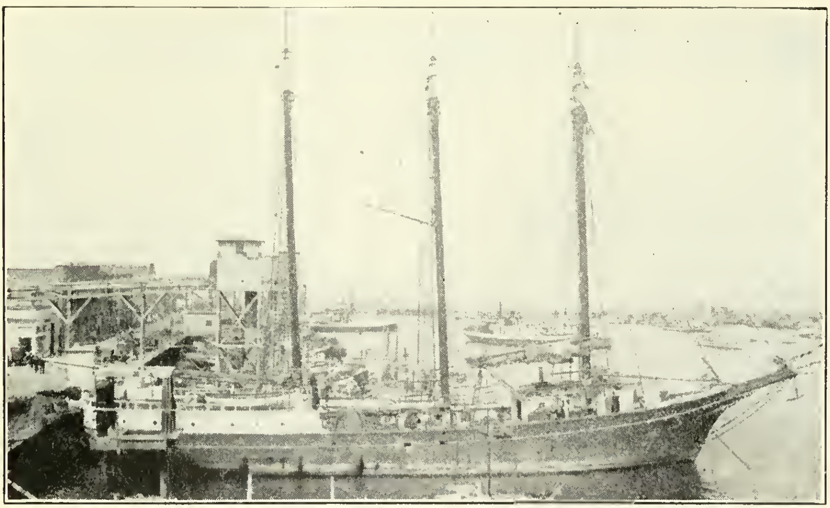


Fig. 45. Tender delivering Mexican yellowfin tuna at San Pedro. Photo by G. R. Chute, June 15, 1927.

was no way in which the Commission could require any definite percentage of the fish to be packed.

As a result of these two decisions, both the canners and the Commission were placed in a position which was far from satisfactory, so it was decided to carry the contest to the state legislature. All were agreed that the law should be definite and without ambiguity and should have "teeth" in it, in order that it might be rigidly enforced and thus allow no canner or group of canners to use a greater per cent

of sardines for reduction purposes than any other canner. The competition between individual canners and between the localities of Monterey and San Pedro was too keen to permit anyone to get an advantage by using more than the specified amount in the reduction plant.

In view of past experience in trying to agree with canners and those who would take sardines for the manufacture of an edible oil, the Commission did not try to agree on a bill with the canners, but had introduced a bill allowing practically no overage. The canners, on their part, had a bill introduced which would permit 40 per cent of the catch to be used for reduction. After a strenuous battle and when it began to look as though no bill would be passed, a compromise was reached which permitted $32\frac{1}{2}$ per cent of the catch to be used for reduction. The ambiguities of the old law were cleared up as far as possible, and more "teeth" put in the law. To get the bill through the Assembly, it was necessary to provide a measure in the bill whereby the Commission could issue a revocable permit to companies to take sardines and, by a reduction process, manufacture edible oil or edible fish flour products. It was understood that this was only done in order to protect the investment of the three companies already operating under a similar provision of the old law, and that no additional permits were to be granted.

A provision providing closed seasons for sardines, which had been a part of the canners' bill, was adopted. These seasons, which are different for northern and southern California, were advanced by the canners as a conservation measure and they claimed it would result in a reduction of the catch. To arrive at these seasons, the ten-year record of the catch, by months, in the two districts, as compiled and published by this bureau, was used, and it is significant that the seasons were so arranged that it was to be expected the two districts would have about the same catch of sardines. In southern California the season runs until the first of April, which is well into the spawning season, while at Monterey the season closes on February 15th. These seasons did not make the catch in the two districts equal, as expected. At Monterey the months of November and December, which are usually months of poor catches, were made into good months in the 1929–30 season by the introduction of large purse and ring net boats which went far up the coast for their fish. The result was a considerably larger catch at Monterey than in southern California, and there is already talk of a readjustment of the season so as to make the two districts equal.

After the signing of the bill by the Governor, the canners met with the officers of the Division of Fish and Game and the director of the Department of Natural Resources, and pledged themselves not only to abide by the new law but to assist the division with its enforcement. They appointed a committee of three to work with the division to bring about a friendly spirit of cooperation. One of the first suggestions of the canners was that the division place additional inspectors in the canneries, so there would be at least one inspector for each plant to check on the amount of sardines received. The amount of the pack of each was to be checked through the daily pack reports and through the number of cans delievered to each plant. It was necessary to do this, they said, to remove the temptation for any canner to cheat and

thus get an advantage over the others. This was done and, in addition, an auditor was employed continuously to check the books and records of the plants. This plan worked very satisfactorily, but the expense is excessive. It is estimated that the policing of the sardine canneries costs $30,000 yearly, without taking into consideration the expense of regular employees engaged in the work.

The season of 1929–30 again showed a great increase in the sardine catch, as well as in the production of canned fish, oil and meal products, in spite of the closed seasons which it was claimed would reduce the catch 20 per cent. There was again an overproduction and there will be a considerable carry-over into the next season. The price of all sardine products has declined and it is now evident that relief does not lie in the larger percentage which may be used in reduction plants.

The only right solution to the sardine problem is to do away with what is termed ''overage'' and require that no sardines be received by the canneries in excess of what is to be canned. We believe the majority of the canners agree with this.

CHANGES IN FISHING METHODS

One of the features in the sardine fishery has been the changes in fishing methods. The lampara had come into general use for catching sardines both in southern California and at Monterey. The difficulty of supplying from local fishing grounds the increased demand of the canneries for sardines in southern California led to the use of purse seining at San Pedro. In the season of 1925–1926 there were 33 purse seine boats fishing sardines. They were more successful than the lampara boats, mainly for the reason that their larger size enabled them to extend the fishing grounds to the Santa Barbara Channel Islands, 80 to 100 miles distant, and thus overcome the growing scarcity of sardines in the local waters.

Some of the lampara men purchased purse seine boats. The rest improved their nets by enlarging them and by equipping them with rings so that they could be pursed in much the same manner as the regular purse net. By the end of the year 1928 the lampara net had been abandoned by the sardine cannery fishermen and the modified lampara or ring net had taken its place.

The ring net is even more successful than the purse net and during the past two years it has been in process of eliminating sardine purse seining.

The conversion of the many large purse seine boats located in southern California into sardine fishing boats, together with the improvement of the lampara boats by adopting the larger and more efficient ring nets, added not only to the number of boats but greatly increased their efficiency.

It is significant that this greatly increased fishing effort has not been able to increase the sardine catch in local waters. The increased catch of sardines has been the result of extending the fishing area to include the Santa Barbara Islands, an unmistakable indication of depletion.

At Monterey the fishermen have been slower to change their methods. A strong lampara fishermen's organization was able in large measure

to prevent radical changes. Another cause of this delay was the difficulty of unloading large boats by the inclined cable method there used. Two purse seine boats had operated for several seasons for the K. Hovden plant at Monterey. These boats were enabled to unload their catch by the utilization of a suction tube running out to a crib anchored beyond the rocks and into which the boats could unload their catch without danger.

The growing scarcity of sardines in the local waters, especially during certain months, led canners to break away from the domination

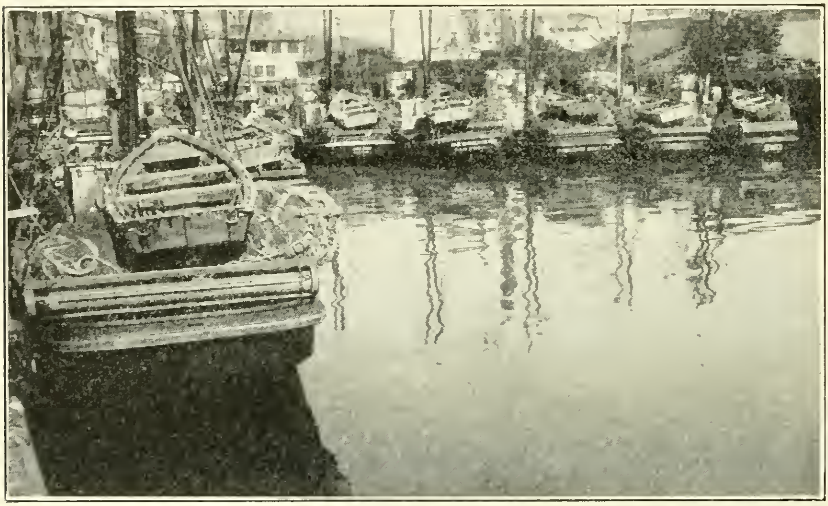


FIG. 46. Purse seine boats moored at Fish Harbor, San Pedro. Photo by G. R. Chute, February 1, 1927.

of the lampara fishermen and to bring in purse seine boats. With the 1929–30 season 22 large purse seine boats were added to the Monterey fleet, and proved very efficient. During the times when sardines were scarce these larger boats were able to extend the fishing area to the north 80 to 100 miles, where they found the fish much more abundant. The lampara fishermen, in self defense, adopted the ring net, while some of them bought purse seiners.

The fishing effort has been growing at Monterey. More efficient methods, more boats, larger lighters and larger limits. Increased effort here, as in southern California, has not increased the catch in local waters. The increase has been brought about by the fishermen going farther for their fish. Along with this has been the lengthening of the periods when they could get no sardines in local waters. All of which indicates depletion.

MACKEREL

In 1928 the mackerel jumped from tenth place in importance among our fisheries to a place second only to sardines. Prior to 1928 very few mackerel were canned in the state, the catch going almost entirely to the fresh fish markets. In 1927 the total catch for the state was less than 5,000,000 pounds. In 1928 the catch jumped to over 35,000,000 pounds. In 1929 the catch was increased to almost 58,000,000 pounds.

The reason for this sudden development was a demand for canned mackerel and, in response, mackerel canning developed on a large scale. In 1928 a little over 388,000 cases were canned. In 1929 this amount was increased to over 600,000 cases. By far the most of these mackerel were canned at San Pedro, while San Diego was second in importance, with Monterey third. A full handling of this development can be found in Fish Bulletin No. 20, "The Commercial Fish Catch of California for the Year 1928."

EXTENSION OF FISHING TO DISTANT WATERS

The great increase in the landings of fish in California has been due to the species used for canning. In 1928 there was actually a decrease in the amount of fish delivered to the fresh fish markets. The indications are that our local fishing banks are not able to supply the increasing demands. Some of our species, like the salmon, white sea bass, southern halibut and albacore show unmistakable evidences of depletion. To supply the fresh fish markets we are more and more depending on fish from off the coast of Mexico and on shipments from Oregon and Washington.

There has been a decline in the catch of tuna in our local waters and, to supply the demand of the canners, tuna fishing has been

FIG. 47. Purse seine boat with a deck load of local bluefin tuna delivered at San Pedro. Photo by G. R. Chute, July 12, 1928.

extended for great distances south of the United States' boundary line and tuna are even being imported from Japan for canning purposes. As the tuna fishing has been pushed to the south along the peninsula of Lower California, larger and better boats have been built. A large fleet of these boats known as "high seas boats" are now employed, some of them 150 feet in length, powered with Diesel engines and refrigerator plants with storage space for keeping the fish. These boats have fished as far south as the equator and for many miles off shore. It has been a most remarkable development and it now seems certain

that the future tuna supply for the canneries of this state will be brought mostly from distances beyond one thousand miles. See articles by W. L. Scofield and Geraldine Conner in Fish Bulletin No. 20.

SALMON

The problem of saving the last remnant of the Sacramento salmon run is still with us. In our last report we gave in detail the efforts the division had made over a period of ten or twelve years to get adequate legislation to prevent the commercial extinction of this once most valuable of the state fishery resources and how they had failed. Practically all commercial salmon fishermen and commercial fishery interests agree that the salmon which enter the Sacramento-San Joaquin rivers for the purpose of spawning are near to commercial extinction, and they agree that something radical needs to be done. They do not agree, however, on what the radical measure should be. The commercial fishermen who troll for salmon in the sea think that the river fishing should be stopped. The river fishermen think that sea trolling should be stopped and, while these conflicting interests have battled each other, sportsmen have succeeded in getting our streams opened up again to salmon spearing. At the 1927 session of the legislature, the division attempted to have a bill passed which would have eliminated sea trolling. This measure was defeated, mainly by the argument that the states of Oregon and Washington permit sea trolling and fishermen of those states would continue to catch our salmon, which go into their waters, and would even fish off our coast beyond the three-mile limit, while our fishermen would not be able to fish, or if they should fish beyond the three-mile limit, they would have to deliver their catch in Oregon. While this was not a very good argument, it was sufficient to defeat the measure. A lack of support on the part of river fishermen and the general public was a large factor.

At the 1929 session of the legislature the division sponsored a bill which would have closed the Sacramento River to fishing except during the winter and spring. It would have eliminated the river fishing for the main fall run. The bill also provided a closed season for sea trolling which was uniform for the entire coast of the state. This last measure was to do away with certain legal difficulties connected with the enforcement of the closed trolling seasons. This proposed change would give added protection to the salmon against trollers from Mendocino County to Monterey Bay. The measure establishing the uniform trolling season was adopted, but the proposal to close the river during the time of the fall run was defeated, mainly by the argument that it was the sea trolling which should be stopped rather than river fishing, and that its adoption would be to the advantage of the San Francisco wholesale fish dealers. This last argument was unfair, for the San Francisco dealers, who supported the bill, were moved by a genuine desire to save the salmon of the Sacramento. They knew that it did not pay them to maintain salmon receiving stations on both the river and the coast for the dwindling number of fish which are caught. They also realized the difficulties of entirely eliminating sea trolling in this state while trolling is permitted in Oregon. They stated they would be in favor of stopping the trolling if all trolling could be stopped.

The fact remains that our salmon are still without adequate protection. The salmon supply in the state has been reduced to a point where there is little profit for fishermen to fish for them, or for dealers to maintain stations to receive them. Must we wait until there is no profit for anyone and the opposition vanishes before anything is done? If our salmon runs are permitted to fade away to that stage, it is doubtful if they can ever be built up again.

INTERNATIONAL PACIFIC SALMON FEDERATION

In 1925 the fisheries officials of the United States and Canadian governments, together with the fisheries officials of the three Pacific coast states, British Columbia and Alaska, met at Seattle and formed an organization known as the International Pacific Salmon Federation. California, the United States and Canada had been working independently on salmon investigations, and it was for the purpose of coordinating these activities and to provide a means of mutual discussion of salmon problems of interest to all that the organization was formed. Meetings were to be held yearly. At the first two meetings, the subject of salmon trolling was discussed at length. All but the Canadian officials agreed that trolling should be stopped. The officials of Canada contended that, in trolling off the British Columbia coast, their fishermen catch very few immature salmon, and they believed that the salmon they were catching were from British Columbia streams.

To determine this point, extensive tagging of troll-caught fish was planned and carried out by British Columbia and the three western states. British Columbia was much more successful in its tagging operations than the three states, and is still carrying on this work. The three states were so unsuccessful that they have abandoned the work, preferring to mark young salmon at the hatcheries and trust to recovering them later from the trollers. The tagging experiment disclosed the fact that many of the salmon caught by trolling off Vancouver Island are from the Columbia River. In spite of this finding, the Canadian officials do not favor any great restriction on their trolling and they do not care to enter into discussions of controlling trolling through international treaty. We can but agree with their point of view, for they have been trying for nearly twenty years to enter into a treaty with the United States to protect the depleted salmon runs in Puget Sound and the Fraser River. In the Fraser River controversy, the United States has been getting most of the fish, while British Columbia has all the expense of artificial propagation on the Fraser River. The Canadians express a willingness to discuss the restriction of trolling after the Fraser River salmon treaty is entered into.

The program for salmon investigations as adopted by the federation, in brief outline, is as follows: Collection of adequate and uniform statistics; tagging experiments; scale analyses of the adult salmon; study of the adult returns from known escapements to the spawning grounds; stream surveys of the spawning grounds; study of the production of seaward migrants from known escapements of parent fish; efficiency of various methods of artificial propagation as compared with natural propagation; effect of transplantation; improvement of spawning areas and overcoming of obstacles, natural and artificial, to the ascent of spawning salmon and to the descent of the seaward migrants; the life

history in fresh water, with particular attention to the factors affecting survival during this period of the salmon's life; life history in the ocean; study of the effect of sea fishing. This program is being followed as closely as funds and facilities permit. So far most of the work has been carried on by the United States, Canada and California, each of which is publishing its results independently.

The last meeting of the federation was held at Stanford University on March 28 and 29, 1930. All of the parties belonging to the federation were represented, with the exception of Alaska and the state of Washington. It may be said that Washington was unofficially represented by Stedman Gray, editor of *Pacific Fisherman*, who acted as secretary. At this meeting a resolution was presented by the fisheries commissioners of Oregon and unanimously adopted, recommending that Washington and Oregon adopt the same closed trolling season as that now in effect in California, which is from September 15th to June 1st. It was also agreed that representatives from California, Oregon and Washington get together at some place in Washington before the next sessions of the legislatures to definitely decide on the wording of the bill to be presented to the separate legislatures.

LEGISLATIVE SALMON RESOLUTIONS AND INTERIM COMMITTEES

At our last session of the legislature, when the important salmon conservation measure sponsored by the division was being held up by the arguments on whether sea trolling or river fishing for salmon was the more objectionable method, a resolution was adopted requesting the Division of Fish and Game to take up with the officials of Oregon and Washington and of the federal government the question of salmon trolling, with the object of restricting trolling by legislation or international treaty. This is being done. In fact, as will be seen under the heading, ''International Pacific Salmon Federation,'' just such a discussion was taken up five years ago and every effort is being made to secure such a restriction of trolling. We have pointed out that an international treaty at this time is out of the question, but Oregon and Washington are alive to the necessity of a closed trolling season.

During the legislative sessions in Oregon and Washington early in 1929, a joint salmon committee was appointed by the two legislatures with the object of agreeing on legislation for the protection of salmon on the Columbia River as well as in the sea off the coast of the two states. The Columbia River problem so overshadowed that of sea trolling that the latter was not reached.

The Oregon legislature at the same session appointed an interim committee of nine members, four of whom are committeemen at large, to make a study and report on what fisheries legislation is needed. A similar committee was appointed by the California legislature which is termed the Fish and Game Legislative Investigating Committee. This California committee, made up of three assemblymen, with Wm. P. Jost, chairman, has held numerous meetings throughout the state and has gone very carefully into the question of conserving our salmon. This committee expects to meet with the Oregon committee for the purpose of discussing the question of salmon trolling.

At the request of the Oregon committee, the Division of Fish and Game was represented at their meeting at Marshfield on May 31, 1930,

by N. B. Scofield, who discussed at the meeting the question of salmon trolling. Several others who appeared before the committee spoke in favor of either eliminating or curtailing salmon trolling. When the committee learned that California has a similar committee, the secretary was instructed to invite them to attend the Oregon meetings. A meeting to discuss salmon questions is to be held at Astoria in the early fall at which time the California committee will probably attend. Out of all this activity and the desire on the part of Oregon to curb sea trolling for salmon, it would seem that the closed season to trolling now in effect in California will be adopted by the two states to the north. California, however, needs a longer closed season than she now has but, due to difficulties in the way of enforcement, is unable to get it while the waters of Oregon are open. We have now reached the stage where we should not rely on cutting down sea trolling alone, especially if we have to wait for the states to the north of us, but we should severely cut down the intensity of fishing on the Sacramento River.

SALMON INVESTIGATIONS

In 1927 an investigation of the past and present status of the Sacramento-San Joaquin salmon was started by G. H. Clark, a member of the staff of this bureau, under the guidance of Dr. J. O. Snyder of Stanford University. The results of this investigation were published last year as "Fish Bulletin No. 17." The bulletin is in three parts. Part I is a historical and statistical review containing a history of the fishery, salmon investigations, artificial propagation and legislation. There is a statistical review of the salmon catch since the year 1874, and, in conclusion, a section on the causes of depletion in which he says: "Overfishing, one of the principal causes, should be curbed and more stringent laws passed to control it, especially outside trolling." Part II of the bulletin is a survey of the spawning grounds. in which is given in detail the conditions on the main streams and tributaries of the Sacramento-San Joaquin river systems, with their obstructions, fish ladders and screens, the time of the salmon runs and the abundance of salmon in each. He estimates that there are now 510 linear miles of spawning beds suitable and available for spawning and that previous to any obstructions in the streams there were at least 6000 linear miles of stream bed suitable for spawning. At least 80 per cent of the spawning grounds have been cut off by obstructions. Part III of the bulletin deals with the life history of the salmon. See also "Shad, Striped Bass and Salmon," by G. H. Clark, Fish Bulletin No. 20.

For a number of years Dr. J. O. Snyder of Stanford University has been carrying on salmon investigations for this bureau. Some of the outstanding results of his investigations have appeared frequently as special articles in CALIFORNIA FISH AND GAME. The following is a brief summary of results and work in progress as submitted by Dr. Snyder:

> The usual statistical and observational work has been carried on. The marking experiments with king salmon, which were begun some time ago, have come to a close and details are now ready for publication. Evidences of depletion are everywhere present, and in some cases the situation appears serious.
>
> The outstanding features of the marking experiments may be summarized as follows:
>
> Hatchery produced, pond reared fish, after liberation, migrate to sea, grow, mature, and return to breed as do native fish.

After entering the sea, they may wander long distances from the mouth of their native stream. Klamath River fish, for example, migrate southward to Monterey Bay, and Sacramento River fish move a considerable distance northward as well as southward.

Individual fish at times remain closely associated for a year or more while at sea, possibly in the same school.

Adult fish return upon their nuptial migration to the stream from which they enter the ocean, regardless of where the eggs were taken.

When yearlings are introduced into, and given a sufficient exposure to the waters of a particular tributary, they tend on their return migration to seek out and enter that tributary, while under less favorable conditions they may scatter to a considerable extent. This is what might be expected in nature, the homing instinct preserving the exact geographic distribution of the species, while the tendency of individuals to straggle provides a means for the spread of the species as opportunity presents.

Studies relating to the life history of the silver salmon were begun by the introduction of considerable numbers of marked and unmarked fish in Boulder Creek and the main channel of San Lorenzo River. Eggs were brought from Redwood Creek, in the northern part of the state, placed in the hatchery at Boulder Creek where, under the care of John Marshall, foreman of the hatchery, they were kept under observation until the ensuing fish were liberated. Silver salmon reared from the eggs of native fish, by C. L. Frame, foreman of Big Creek hatchery, were marked and introduced into Scott and Waddell creeks, and the Pajaro River.

It is expected that the returning adult fish will furnish us with a verification of age determinations which have been arrived at from an examination of the scales of adult fish. Also, some notion may be gained as to whether it is feasible to artificially propagate the species in these streams, and what is the best time and place for liberating the young.

Since the inauguration of an efficient statistical system by the division, the rapid depletion of the salmon fishery has been made apparent. In addition to the ordinary and easily observable phenomena, such as the progressive annual reduction of the catch, the constantly increasing effort expended in making it, the discovery and development of new fishing grounds, the increase of the price paid for the fish, etc., another aspect of depletion, which is less familiar, has appeared. This is an enormous increase in the relative number of two- and three-year fish in the catch, over what may be regarded as the normal of preceding years.

During the season of 1928 it became evident that a considerably larger proportion of small fish were being brought to the markets from sea trolling than ever before. As usual, the fishermen attempted to account for this in various ways, but a small sampling of the Monterey catch seemed to indicate that a large proportion of immature fish was being taken. Of 383 representative samples, 56 per cent were in the second year of growth, and 31 per cent were in the third year. In 1929, a careful survey of the situation was made. At Monterey samples of the catch to the number of 2800 were examined from April 23d to July 29th. Of these, about 17 per cent were in the second year of growth, and 62 per cent in the third year. Approximately 80 per cent of the catch consisted of two- and three-year fish.

Now we fortunately have at hand an age determination of large and representative samples of the Monterey catch for the years 1919, 1920, and 1921, when the relative number of two- and three-year fish did not go over 40 per cent. Unless an unsound inference is being made, it would seem that the supply of old fish is greatly reduced, and that the Monterey Bay catch is considerably reducing the population of young fish which should be left to mature in the near future.

It is intended now to make an investigation of the seaward migrations of the young fish in Klamath River, to make an examination of the spawning beds in a restricted area of the basin to attempt an estimate of the relative production of natural propagation in a restricted area, to get some definite idea of damage done by irrigation, etc. As a part of this program, a trap has been installed at the mouth of Shasta River, where an observer may make a count of the spawning fish which enter the river. No artificially reared fish will be placed in the river, therefore in the course of time a fairly accurate estimate of the results of natural propagation may be made, and some of the difficulties which attend it may be observed.

OYSTERS

One of the earliest fisheries activities in California was the cultivation of oysters. Numerous attempts were made to establish and cultivate the eastern oyster in San Francisco Bay and other bays of the state. To encourage the growing of oysters a law was passed in 1873, under which persons could stake out tide land areas and record the claim in the county recorder's office. Oysters planted on these claims were the property of the person, and it was unlawful for anyone to trespass thereon.

It was found, however, that our waters are too cold for the successful spawning of the eastern oyster, but that it was very profitable to purchase the young oyster spat on the Atlantic coast, ship them out in car load lots and plant them on the prepared beds in San Francisco and Tomales bays. Althought the oyster could not be depended upon to reproduce and thus make the business self-sustaining, the conditions were favorable for the rapid growth of the spat.

The business grew rapidly and the many small oyster companies were later merged into two or three companies. The largest of these was at one time doing an $800,000 a year business. Then this business began to fail. The spat ceased to grow rapidly and the grown oysters were inclined to be thin and watery. It was necessary to cease bringing out the spat and, instead, they brought out the half-grown oysters. Even this method was later abandoned and only the grown oysters were brought out and the oyster beds have been used only for holding the grown oysters until they can be disposed of as the market demands. The once large oyster business shrank to almost insignificant proportions and, except for recent signs of reawakening, has remained in that condition.

It was characteristic of the old oyster industry that experts or scientific investigators were not employed, and then when the industry began to fail it was not possible to determine just what were the changed conditions which made San Francisco Bay unfavorable for the eastern oyster. Records of temperatures, salinity or quantity of food in the water had not been kept, so the real cause is only a matter of conjecture.

In the last few years the methods of science have been employed in the oyster industry on the Atlantic coast and in Puget Sound region. The U. S. Bureau of Fisheries has taken the lead in this work. Notable work has also been done by the states of New Jersey and Washington. The knowledge which has been gained in this work has revived the hope that there is still a chance to build up an oyster industry of large proportions in this state. While it is not probable that the eastern oyster will ever be a success in California, there is now the best of evidence that the little native oyster of the Pacific coast and the Japanese oyster can be profitably cultivated. A recent survey, as well as experiments in California waters by experts of the U. S. Bureau of Fisheries, tells us that we have within the state 5000 acres of tide land, exclusive of San Francisco Bay, which are suitable for growing both the native Pacific oyster and the Japanese species. On Puget Sound, where for years the native Pacific oyster has been profitably cultivated, improved oyster beds are valued at $2,000 per acre. As it costs on an average

of $1,000 an acre to establish the beds, it can be seen that suitable oyster lands are in demand and that they are returning a good profit.

Experiments of the U. S. Bureau have shown that we can expect large profits from the culture of the little native oyster, for they grow much more rapidly here than in Puget Sound. The Japanese oyster also shows the same rapid growth.

There is an excellent and growing market for oysters on the west coast, and they can be profitably shipped for long distances.

One oyster company is now experimenting on a rather large scale in the Monterey Bay region with different forms of collectors and with different methods of preparing the beds, under the direction of the U. S. Bureau of Fisheries, and the results are most encouraging. Claims are being staked out in a number of places in the state, under the old oyster claim law, and a revived interest in oyster culture is apparent.

OYSTER INSPECTION

In the experiments which are being carried on by oyster men, oysters are shipped here from Japan and, as there is the greatest danger that pests will be unintentionally introduced along with them, we have been inspecting all such shipments. One shipment of oyster spat was confiscated and destroyed because it contained many of the egg capsules of the Japanese oyster drill. These were at the hatching stage and to permit their introduction along with the oysters would result later in great loss to the oyster companies. In this work we have had the fullest cooperation of the oyster companies, for they realize the great damage which can be done by this, the most destructive of all the species of oyster drills.

As a result of our inspection the oysters shipped from Japan will be from clean stock and will be carefully inspected before they are shipped. Shipments will not be made at the season of the year when there is danger of bringing in the eggs of the drill or of other pests less destructive in their habits.

It is believed, however, that even with the greatest vigilance, the Japanese oyster drill will gain admission if we continue to receive oysters from Japan. It is proposed that certain waters be set aside for the growing of the Japanese oysters where there will be little chance of the drill spreading to waters reserved for the cultivation of the native oysters.

NEED OF REGULATORY AUTHORITY

There is need of a comprehensive state law which will give the Division of Fish and Game authority to regulate not only the culture of oysters but the culture of other shellfish, such as clams and mussels. State and privately claimed tide lands suitable for shellfish culture should be made available to those who would engage in the cultivation of these shellfish through allotment or lease, and they should be under the regulation and control of the state. It will be necessary to protect natural oyster reefs and to have reservations established for the protection of breeding stock and thus avoid overfishing, as has occurred almost every place where oysters are grown. It will be necessary to carry on extensive experiments under experts to determine the proper methods of preparing oyster bottoms and the best forms of collectors for the

conditions existing in this state. The industry should contribute to the expense of carrying on this necessary work. Oystermen with whom we have talked see the necessity of state control and guidance and desire that such a measure be adopted.

SCIENTIFIC INVESTIGATIONS

Most of the commercial fisheries investigations of the Division of Fish and Game are being carried on by the staff of the State Fisheries Laboratory, at Terminal Island. These activities are the subject of a special report by the acting director of the laboratory, which is made a part of this report.

The bureau has been carrying on a number of other special investigations which are only indirectly connected with the laboratory, and has been assisting others financially. Among these investigations is that of the salmon, by Dr. J. O. Snyder and others working under his direction. A report on this work has been included under the special subject "Salmon Investigations."

The more important of these investigations are as follows:

RESEARCH IN FISH CANNING

As stated in our last report, the Division of Fish and Game, at the request of the fish canners, agreed to turn over $15,000 a year for a period of three years, to the Hooper Foundation of the University of California, for the purpose of carrying on research in connection with fish canning problems. This agreement was carried out and, at its termination at the end of the fiscal year 1928–29, it was agreed to continue the arrangement for another two years. The work has been under the supervision of Dr. Karl F. Meyer, of the University of California, and O. W. Lang has been directly in charge.

Much valuable work has been done on sardine canning, during a period of rapid change in methods, to insure proper packing of the cans and sterilizing of the pack. This work has been carried on in cooperation with the State Board of Public Health, which conducts an inspection of all canning operations, the inspection being financed by the industry. This inspection covers also tuna and mackerel canning operations. During the year 1928 mackerel canning was suddenly developed on a large scale in the state, and the fish canning research laboratory of the Hooper Foundation devoted its attention to the many technical canning problems arising in that industry. A preliminary report and bulletin on mackerel canning was issued in 1929.

HYDROBIOLOGICAL SURVEY OF MONTEREY BAY

Realizing the practical significance of a knowledge of oceanographic conditions in their relation to the problem of conserving the sea fisheries, the Division of Fish and Game has for a number of years encouraged marine biological institutions in the state to carry on oceanographic investigations in the region of our greater sea fisheries. Such investigations it was realized should explain in large part the movements of the schools of fish, as well as give reasons for the natural fluctuations in abundance of fishes due to the comparative success or failure of the annual crop of young. We were therefore greatly pleased when Dr. Henry B. Bigelow, of Harvard University, a leading

oceanographer, was engaged to lecture on oceanography at the Hopkins Marine Station of Stanford University on Monterey Bay, during the summer of 1928.

Dr. Bigelow wished, as part of his program, to make a short but intensive survey of the hydrobiological conditions in Monterey Bay. Before coming to the coast, he asked if the division would cooperate in this proposed survey by putting the patrol boat *Albacore* and crew at his disposal. This we gladly did and, in addition, assigned E. C. Scofield to assist him. The smaller patrol boat *Steelhead* was also used in the work. The work was carried out jointly by members of the Hopkins Marine Station of Stanford University, the Museum of Comparative Zoology of Harvard University, the Scripps Institution of Oceanography of the University of California and the Division of Fish and Game. The results of this survey have been published as a bulletin of the Museum of Comparative Zoology at Harvard College under the title, "Reconnaissance of the Waters and Plankton of Monterey Bay, July, 1928," by Henry B. Bigelow and Maurine Leslie.

While engaged on this preliminary survey of Monterey Bay, Doctor Bigelow encouraged the Hopkins Marine Station and the Division of Fish and Game to continue the work. Cooperative arrangement was therefore entered into between the two whereby the division was to equip the patrol boat *Steelhead* with the necessary winch and cable, and to give the services of the boat and crew to the survey. E. C. Scofield was assigned to take charge of the part of the program which most directly had to do with the problems of the fisheries, more particularly a study of sardine spawning and early life history, including distribution and drift of the eggs and larvae. The two institutions also agreed to each furnish $1,500 a year to cover the general expenses of the survey. The survey is under the immediate supervision of Dr. Tage Skogsberg, of the staff of the Hopkins Marine Station; and other employees of the station are engaged in the analysis of water samples and in handling the materials and data collected.

The work was organized and well under way during the early part of January, 1929, and regular biweekly trips have been made since that time. A full description of this survey, with the objects to be attained, is to be found in an article by Doctor Skogsberg in the January number of *California Fish and Game* for the year 1930. Already important results closely related to fisheries conservation have been obtained. The time and place at which sardines spawn are now fairly well known. A preliminary report on this phase of the investigation was published in the April number of *California Fish and Game* for 1930. It is expected that this hydrobiological work will lead to an understanding of the basic fishery problems which confront us.

After completion of the new patrol vessel *Bluefin*, the *Albacore* was completely overhauled and has been transferred to Monterey, where it will aid in the survey. The winch is being transferred from the *Steelhead* to the *Albacore*, and a new and heavier 1200-meter cable is being added.

STRIPED BASS

A striped bass investigation was begun by E. C. Scofield in the fall of 1925, and field work was carried on until late in 1928. Since that time, the data gathered has been worked up and presented in a report

which is now in final form for the printer. This report will be a valuable contribution to our knowledge of the striped bass, as our knowledge of much of this fish's life history and the exact effect of the present conservation measures has been rather hazy. The report will no doubt be in demand by sportsmen and commercial fishermen alike and by all who are interested in striped bass on the Atlantic coast, which is the original home of this fish. The report is in three parts. In the first, the life history is dealt with, which includes age and rate of growth, spawning, age and size at maturity, migration, and food. The second part treats of the relation of these facts in the life history to the problems of conservation. A few of the subjects treated are: The commercial catch of striped bass; explanation of the term "season"; methods of sampling; length frequencies of the monthly commercial catch; age groups in the commercial catch; selectivity of the commercial nets; spawning period; summary; and under "Conclusions" are given: Effect of the regulation of nets; twelve-inch limit; ten-pound limit; closed seasons and closed districts; recommendations. We know of no report which so thoroughly and in such a practical manner works out the complicated and baffling problems connected with the conservation of a fishery. The third part is given over to a discussion of the methods of fishing. This includes a description of all types of gear and their use; the boats and the handling of their catch. There is also included a list of literature cited.

SEA LIONS

Paul Bonnot for a number of years has carried on an investigation of the seals and sea lions of California. The results of this work are contained in occasional articles in *California Fish and Game* and in Fish Bulletin No. 14, published in 1928. A census of the sea lions, taken at yearly intervals, discloses the fact that there are less than 8000 of these animals in the state and that the number is yearly becoming less. Mr. Bonnot recommends that the size of some of the rookeries be reduced by humane and scientific methods. The rookeries should not be destroyed, he believes, but some of them should be reduced and kept at a comparatively low level by killing a certain percentage of the new-born pups. To do this work properly, it will be necessary for the state and the federal Department of Commerce, through the Bureau of Fisheries, to cooperate, as the largest rookeries are on federal lighthouse reservations under the jurisdiction of the Department of Commerce. It will also be necessary to amend our state law so that the killing or capture of sea lions will be under state authority, by prohibiting killing or capture except by state permission.

Mr. Bonnot has also carried on a number of investigations of minor fisheries, some of which are little known. Among these investigations are the whitebait fishery, abalones, sea weed and kelp industry, shrimp fishery and the oyster industry. His reports have appeared from time to time in California Fish and Game.

SEA FISHERIES PATROL

The great advance in recent years in the fisheries of southern California, especially the building of large "high seas" Diesel-driven fishing boats which operate great distances from port, has made it neces-

sary to replace the patrol boat *Albacore* with a larger and better vessel. Therefore early in 1930 the contract was let for such a vessel to the San Diego Marine Construction Company of San Diego and the boat was launched on May 24th. The new boat, christened *Bluefin,* is of heavy construction with graceful lines and fine finish. She is 86 feet in length over-all and 80 feet on the water line. The beam is 18 feet 6 inches and the draft about 7 feet 9 inches. She is a single screw vessel, powered with a 200-horsepower Diesel, Atlas Imperial engine, and has a speed of 12 knots. Her tanks hold enough fuel for a cruise of over 4000 miles. The engine is entirely controlled from the pilot house. The winches are electrically driven. She is manned by a crew of five men, and Walter Engelke, formerly in charge of the old *Albacore,* has

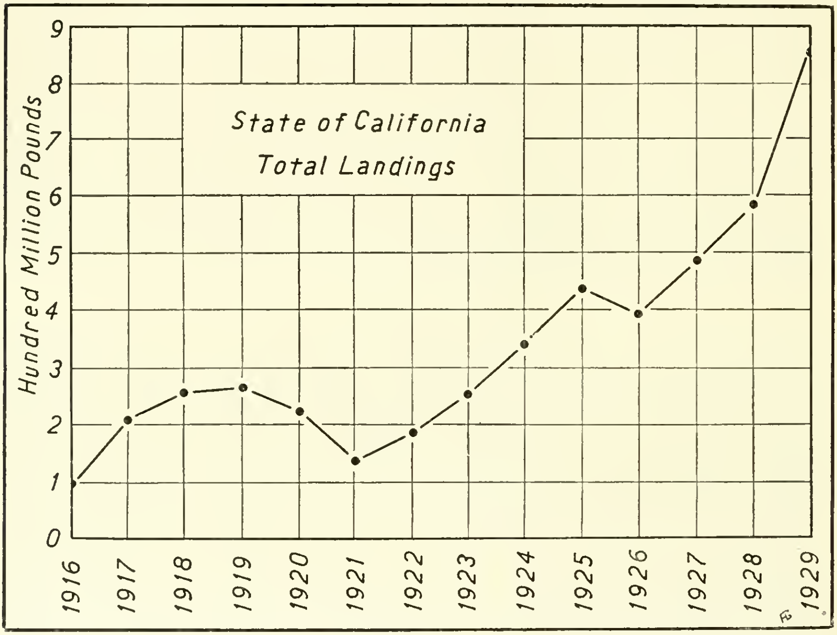


FIG. 49. Total landings for State from 1916–1929, including all fish, mollusks and crustaceans.

been made captain. The boat is equipped with tanks of carbon dioxide which will automatically flood the engine room in case of fire. The boat is to be used not alone for patrol but for fisheries research, and one of the special features is a double drum, electrically operated winch, which carries 2400 fathoms of five-sixteenths-inch steel cable to be used in oceanographic work in connection with fisheries research. The boat is well equipped and has good accommodations for the crew and for the scientific staff while aboard. The fairly large salon gives ample room in which the research men can work and there is a small laboratory with sink for the scientific supplies and for handling the material gathered by the tow nets and water sampling apparatus. The cost of the boat, including the double drum winch and cable, was $63,000. Already the *Bluefin* has been active on patrol work and has enabled the

investigators to trace the spawning area of the sardine to a point 200 miles off shore in southern California and a point 85 miles off shore near Monterey Bay.

The patrol boat *Albacore*, which has been in use for twelve years and is in fairly good condition, will be given a new deck and bulwarks and

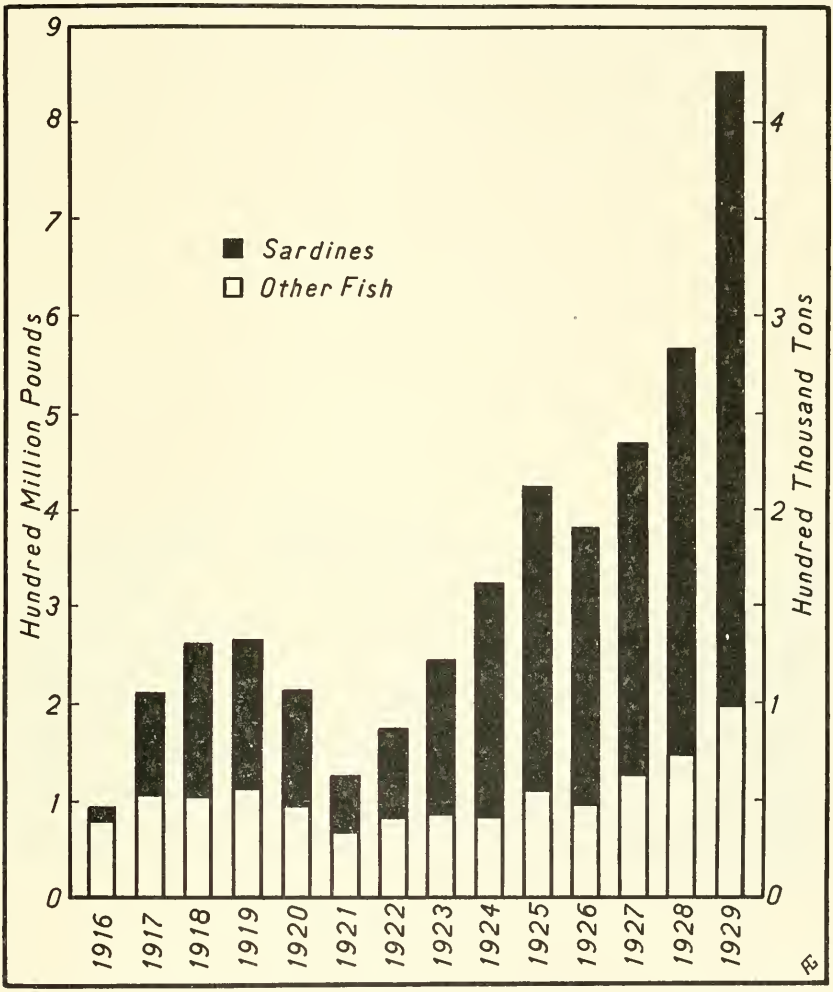


FIG. 50. Total landings of fish (exclusive of mollusks and crustaceans) in California. Importations from Japan and Hawaii have been omitted. Catches south of the International Boundary have been included. "Other Fish" consist of the combined species of fish except sardines. The top of the black bar represents the total of our so-called "local" catch.

after a thorough overhauling will be sent to Monterey Bay, where she will be engaged in patrol work. She will also be used in hydrobiological survey being carried on under a cooperative arrangement between the Division of Fish and Game and the Hopkins Marine Station. After she reaches Monterey, about August 1st, the winch now being used on the small *Steelhead* will be transferred to the *Albacore*, and it is

planned to equip the winch with a longer and heavier cable. The *Albacore* will be kept pretty busy, with both the biological and patrol work of the region.

Provision has also been made to replace the patrol boat *Quinnat,* now in use on San Francisco Bay under the supervision of the Bureau of Patrol, with a moderate priced boat which will be suitable for patrol outside the heads. The *Quinnat* is not suitable for outside work except in very fair weather.

With these three boats, the *Bluefin*, *Albacore* and the new *Quinnat,* the outside patrol can be well taken care of.

REPORT OF THE CALIFORNIA STATE FISHERIES LABORATORY

By W. L. Scofield, Acting Director

As stated more fully in the twenty-ninth and thirtieth biennial reports, the research program of the Bureau of Commercial Fisheries concerns itself with determining the present state of the supply of our more important commercial fisheries, the determining of the presence or absence of over-utilization and the examination of such questions as bear directly upon the effectiveness of present or proposed legislation for the protection of the state's fisheries resources.

The biennium 1929–1930 has been a period of accomplishment and the present report may well confine itself to summarizing the progress already made.

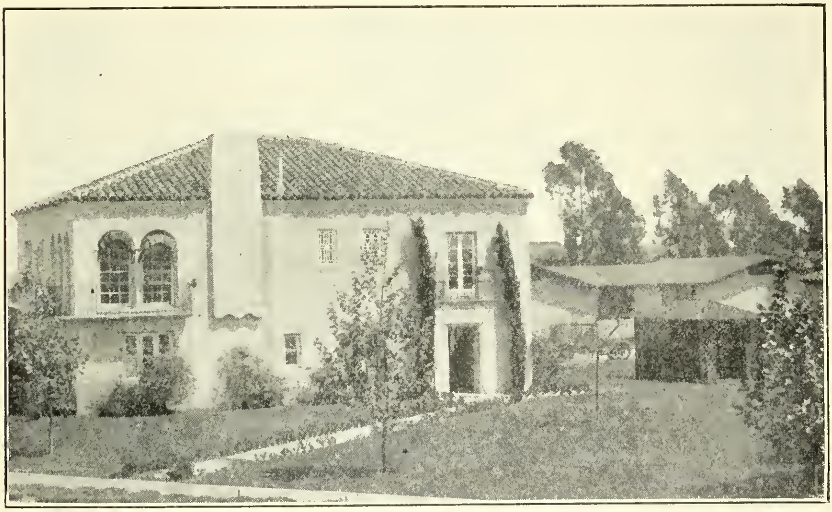


Fig. 48. California State Fisheries Laboratory, Terminal Island, California. Photo by D. H. Fry, Jr.

ANALYSIS OF BOAT CATCHES

The outstanding accomplishment of the last two years has been the perfecting and application of methods for analyzing the catches of individual fishing boats. The daily catch of a boat utilizing a certain type of fishing gear is being used as a unit of fishing effort. Average daily or monthly catches for a representative group of boats over a period of years are compiled and analyzed so as to discount price changes, altered fishing methods and such other economic factors as affect the catch. As a result we have a fair picture of the changes occurring in the actual abundance of our commercially important fishes.

This work is dependent on the detailed information recorded on the fish buyers' receipt book tickets. The perfecting of our statistical system and the orderly filing of the receipt tickets were necessary preliminaries which have now been accomplished to such an extent that we are able to go forward with the studies for determining depletion by means of boat catch analysis. Such determinations have recently been made in four important California fisheries and similar studies will be made in other fisheries as rapidly as possible. The catches of striped bass, white sea bass, bluefin tuna and California halibut have been analyzed, and in two of the four fisheries the supply was found to be diminishing with alarming rapidity. In the case of bluefin tuna the available supply seems in no immediate danger. The striped bass fishery of the San Francisco Bay and Sacramento River region was found to be in a healthy condition due chiefly to increasingly stringent protective legislation during past years.

SARDINES

The major problem of our research program is to gain an understanding of the available sardine supply and to learn the effects of our present utilization of this most important species. We early found that the study of the sardine supply off the California coast offered unforeseen difficulties in that the success of spawning was extremely variable from year to year, resulting in dominant and comparatively lacking age classes. We found extreme seasonal variation in the sizes appearing in the commercial catch and discovered baffling spawning or feeding movements in and out of the fishing areas. The determination of age, rate of growth and size at maturity were found to be unexpectedly difficult because of the complex nature of this fishery.

During the last biennium we have made gratifying progress toward the solution of the more important problems connected with this difficult study. Our work at San Diego has furnished an understanding of the rate of growth and age of the small sardines taken at that port. Through cooperation with Stanford University in the hydrographic survey of Monterey Bay, we have learned much of the spawning localities, eggs, and larval stages of the sardine. Our sampling of the commercial catch at San Pedro and Monterey has given us a better understanding of the rate of growth of the larger fish, the appearance and recurrence of dominant size classes in the catch and has suggested criteria that may be used in determining the presence or absence of over-fishing. Studies of egg samples are giving us the determination of the spawning season, the size of fish at sexual maturity, the proportion of the fish population maturing at any given size and the normal number of spawnings to be expected from individuals.

Detailed examination of the variations in the yield from various fishing localities has given us significant though not conclusive evidence of the strain upon the fish population suffered under present utilization of our supply. Close watch has been kept upon changes in the amount and character of the fishing effort expended and the results have been published. Field work has been extended to include observations at monthly intervals of the sizes of fish and state of sexual maturity of sardines at Pittsburg.

MACKEREL

In past years the mackerel fishery of California was conducted on a small scale but during the summer of 1928 this choice fish was canned at several of the packing plants, and as a result the total catch figures suddenly jumped from insignificance to a position of prominence among the leading fisheries of the state. As this fishery gives every promise of continued importance, it was at once given a place on our research program and two investigators were assigned to this spectacular fishery. The character of the commercial catch and sampling of fish sizes at regular intervals has been conducted through one fishing season. Studies have been initiated to determine the spawning, age, rate of growth, size at maturity and abundance of supply of this species.

BARRACUDA

Life history studies of the barracuda have yielded clear-cut results directly applicable to determining the effectiveness of the present protective legislation and the possible need for further protection. Publication of the final results is awaiting the completion of a study of the abundance of the supply by means of analyzing the boat catches.

PISMO CLAM

A census of the supply of Pismo clams is made during a three-day period each fall. The results prove conclusively that this superior clam has been depleted to such an extent that the yield is now but a very small fraction of what it was but a few years ago. This is one of several examples of a source of food supply that has been almost obliterated through unwise use. It is hoped that the section of Pismo Beach now closed to digging will serve as a spawning refuge and prevent the extermination of this valuable species.

DRAG NETS

An examination of the paranzella or drag net fishery of the state has been completed and the report will soon be published. This includes a full history of this pioneer fishery, a description of the gear used at various ports of the state, an account of fishing methods, and the part that this fishery played in the development of ocean fishing in California.

MISCELLANEOUS RESEARCH

In addition to the more formal projects mentioned above, the research staff is constantly called upon for minor emergency studies needed in the solution of legislative and administrative questions. In many cases the results are intended merely for the use of the Bureau of Commercial Fisheries in supervising our fishery resources. Frequently, however, the results are of sufficient interest to warrant their publication in the quarterly magazine, *California Fish and Game*. In the pursuance of such studies the staff members do much of their work in the fish sheds and supplement their field observations by frequent trips on the fishing vessels to learn actual conditions at first-hand.

LIBRARY

An essential of effective research is a fairly complete reference library, and we are fortunate in having selected reference works with such care that we now have a very usable and complete library of comparatively small bulk. The library now contains some 3600 volumes and pamphlets.

BIBLIOGRAPHY

The preparation and publication of a bibliography by a trained research worker familiar with the problems and the literature is of great use to all our present and future research staff. In addition, the distribution of a carefully prepared list of references is greatly appreciated by everyone directly connected with fisheries investigations or interested in the findings of such work. During the last biennium we have published a bibliography of the tunas which has met with most flattering praise from institutions and libraries throughout America and Europe. Similar bibliographies are now in course of preparation for sardines and mackerel.

STATISTICAL DATA

Exact and dependable knowledge rather than assumption is an essential in effectively administering our resources. The Bureau of Commercial Fisheries collects an unusually large amount of direct records of the conduct and developments in the fishing industry. Most of these data are summarized and printed in the biennial reports, CALIFORNIA FISH AND GAME, fish bulletins, or as separate pamphlets of the Division of Fish and Game. The greatest bulk of such fisheries data is contained in the records of fish landings at the ports throughout the state. In the twenty-ninth biennial report there was mention of a plan to represent statistical information to the people of the state in a more readable form and to make the salient features more readily grasped by using charts and diagrams. In 1928 this plan was carried out and Fish Bulletin No. 15 was issued. In the following year Fish Bulletin No. 20 carried on the idea, and the third bulletin of this series is now being prepared for the printer. These bulletins present the landings of all species of fish in the various districts, show changes from year to year, and picture seasonal runs by means of graphs of the monthly catches. The third bulletin is presenting additional data covering the number and sizes of boats engaged in the industry, and we hope to enlarge future bulletins to include additional data such as number of fishermen engaged in each fishery, amounts and kinds of gear, investments in equipment and developments in this great industry.

COMMON NAMES OF FISHES

In past years much confusion has resulted from the lack of uniformity in the use of common names for our fishes. As provided by law we have adopted an official common name for each of our commercially important fishes. In order that fishermen, dealers, cannery men and other interested citizens might identify the fishes and know to which species the adopted name properly applies, we have prepared for publication a list of the common names, one name to a page, accompanied by a photograph of the fish in question, a brief description in popular

language and notes on the distribution, importance and usefulness of the species. This handbook of our fishes contains a readily usable key to the fishes in nontechnical language and a glossary of fishery terms in common usage.

PUBLICATIONS

During the interval 1929–1930, many fishery studies were concluded and reported in the series of fish bulletins. In fact more reports were published during this two-year period than were produced during the preceding years since the laboratory was established. Sixteen bulletins (numbers 14 to 29, inclusive) have been issued or are now in press. In addition six other reports are nearly ready for the printer and will doubtless be issued before the close of 1930.

Fish Bulletin No. 14, by Paul Bonnot, is a census of the seals and sea lions along the California coast. No. 15 presents the figures of fish catch for the years 1926 and 1927, with explanatory text and many graphs. No. 16, by Frances N. Clark, reports the life history of the jack smelt. No. 17, by G. H. Clark, deals with the salmon fishery of the Sacramento-San Joaquin river basin. No. 18, by William C. Herrington, summarizes the recent findings from the Pismo clam annual census. No. 19, by W. L. Scofield, records the gear and fishing methods employed in the sardine fishery of Monterey during past years. No. 20 presents the 1928 catch figures with text and graphs. No. 21, by S. S. Whitehead, is an analysis of the boat catches of white sea bass. No. 22, by Genevieve Corwin (Wheeler), is a biblography of the tunas. No. 23, by J. B. Phillips, contrasts the fishing success of the purse seine and ring net boats in the Monterey sardine fishery. No. 24, by J. A. Craig, is an analysis of the boat catches of striped bass in the San Francisco Bay and Sacramento River region. No. 25, by three members of the laboratory staff, is a presentation of the catch locality records for the sardine fishery of the state. No. 26, by Frances N. Clark, deals with the average sizes of sardines in the commercial catch at the chief fishing ports of the state. No. 27, by D. H. Fry, Jr., describes the construction, operation and history of the ring net gear as used in California. No. 28, by Lionel A. Walford, is a handbook of commercial and sport fishes of California, with photographs and descriptions of each species. No. 29, by Eugene C. Scofield, deals with the life history and industry of the striped bass.

REPORT OF THE LEGAL BUREAU

By Eugene D. Bennett, in charge

The work of the legal department of the Division of Fish and Game probably has more ramifications than that of any other division in our state government. During the past biennium this work has been carried on by Mr. Eugene D. Bennett, with the assistance of Mr. Ralph W. Scott, at the office of the division at San Francisco.

The legal activities of the division may be summarized as follows:

I

Prosecution of civil actions in the superior courts to enjoin public nuisances such as pollution of public waters, the maintenance of dams without fish ladders, diversion of waters without fish screens and other actions involving the preservation of fish and game. These actions are instituted in conjunction with the office of the Attorney General and in the name of the people of the State of California. The attorneys for the division appear as attorneys of record in these cases and handle all matters appertaining thereto.

II

Defense of all actions instituted in the federal and superior courts or in any of the higher or inferior courts against the division, the Commission, or any employees thereof in their official capacities.

III

Prosecution of criminal cases in the justice or police courts involving violations of fish and game laws, when requested to do so by the various district attorneys. Usually the deputy fish and game commissioners prosecute their own cases. But where a jury has been demanded or where the facts surrounding a case present some unusual features, technical question, or local angle, the attorneys for the division appear. Eleven of these cases were prosecuted by the division during the biennium.

IV

Rendition of opinions, formal and informal, for sportsmen throughout the state and those identified commercially with fish and game, such as fish packers, game farmers, propagators of domestic trout and the like. The attorneys for the division are constantly called upon to interpret the various fish and game laws for the public generally and for the employees of the division, particularly the men in the field.

V

The drafting and preparation of leases and agreements for the leasing or acquisition of game refuges, bird sanctuaries, hatcheries, egg-taking stations and the like.

The following is a resumé of the major cases handled by the legal department during this biennium.

UNITED STATES DISTRICT COURT

Van Camp Sea Food, Inc., et al. vs. *Department of Natural Resources.* This action was commenced in the U. S. District Court at Los Angeles to restrain the department and its officers from executing the state statute limiting and restricting the use of sardines in reduction plants within California. Inasmuch as the proceeding attacked the constitutionality of the fish reduction act (Stats. 1925, chapter 525), the matter was heard before a court of three judges, of whom one was a judge of the U. S. Circuit Court of Appeal. Decision was rendered in favor of the Department of Natural Resources and the complaint of Van Camp Sea Food Co. et al. was dismissed.

SUPERIOR COURT

People vs. *Associated Oil Company.* This is an action commenced in Los Angeles County to enjoin seventy oil operators at Huntington Beach from polluting the waters of the Pacific Ocean with petroleum. The case went to trial before Judge Leon Yankwich at Los Angeles. It was dismissed as to several of the defendants prior to the trial and during the trial in view of the fact that they had altered the method of operation so that future pollution would be impossible. With these exceptions, however, judgment was made and entered on August 29, 1928, against all defendants except two. Subsequently some of the defendants made motions for new trials which were denied.

People vs. *Submarine Oil Company et al.* This is an action to restrain four oil producers from polluting the waters of the Pacific Ocean at Summerland with petroleum. In this action the Commission was successful and injunction was entered on April 19, 1929.

People vs. *Gibson et al.* This is an action commenced in the superior court of Trinity County to enjoin the defendants from maintaining a dam until such time as they install a fish ladder as required by law. This action was set for trial but was subsequently dismissed when the defendants installed the fish ladder required.

People vs. *Enos et al.* This is a suit instituted in Trinity County similar to the previous case. This case terminated in the same manner as the previous case, when the defendants installed their fish ladder.

People vs. *Central Mendocino Power Co.* This is an action instituted by the division in Mendocino County to enjoin the defendant power company from maintaining a dam in James Creek until such time as it installs a fish ladder therein in accordance with an order of the division. Judgment rendered in favor of the defendant on March 5, 1928. No further action has been taken due to the findings of the trial court that the stream course had become so altered that fish no longer ascend to the location of the dam.

People vs. *Glenn-Colusa Irrigation District.* This is an action instituted by the division in the superior court of Glenn County to enjoin the defendant district from diverting water from the Sacramento River into its irrigating ditches until such time as it installs a fish screen at

the intake thereof in accordance with the order of the division. This case was tried before Judge H. S. Gans of Red Bluff at Willows on May 19, 1930. It was then submitted to the court on briefs.

People vs. *Kittle-Jocrissen Canning Company, Inc.* This is an action commenced in the county of Sacramento to recover delinquent taxes for the privilege of taking fish as provided by chapter 687, Statutes 1917. Judgment was entered in favor of the People on October 16, 1928.

People vs. *Lomita Gasoline Co. et al.* This is an action to restrain six oil companies from polluting the waters of the Pacific Ocean at Long Beach with petroleum. This case was tried July 17, 1928, and judgment was entered on August 6, 1928, against four of the defendants, the action having been dismissed as to the remaining two defendants when they changed their operations so as to prevent future pollution.

Loew vs. *Carpenter et al.* This is an action commenced by the owner of 270 live geese for an injunction to prevent the seizure thereof by deputies of the Fish and Game Commission. The geese are used as decoys. The case is still pending.

People vs. *L. A. Sea Food Products Co.* This action was instituted in the superior court of Sacramento County to recover delinquent taxes which became due to the state under the provisions of the Fisheries Tax and Regulations Act (Stats. 1917, chapter 678). The action was subsequently dismissed when the defendant paid the amount due in full.

People vs. *Cain Irrigation Company.* This action was commenced in the superior court of Mono County to enjoin the defendant from diverting water from Rush Creek into its irrigating ditches until such time as fish screens are installed. The action is awaiting trial.

People vs. *Cain Irrigation Company.* This case is similar to the previous case with the exception that the installation of a fish ladder is involved instead of fish screens. The matter is awaiting trial.

People vs. *Fields.* This is a suit in the superior court to enjoin the defendant from impounding water in Trinity County until such time as an adequate fishway is installed to permit fish to pass over and around its dam. This action was dismissed when the defendant installed the required ladder.

People vs. *Monterey Canning Co.* This was an action commenced in the superior court of Monterey County to prevent the defendant from using sardines in its reduction plant in excess of the amount allowed by law and to close the plant for a period of one year. This case was tried by Judge J. R. Welch of San Jose and on March 11, 1929, judgment was rendered for the people which contained an order of the court closing the plant for a period of three months.

People vs. *Carmel Canning Co.* Same as previous case.

People vs. *San Carlos Canning Company.* Same as previous case.

People vs. *Seapride Canning Company.* Same as previous case.

People vs. *Southern California Fish Corporation.* This action was similar to the four preceding cases except that the same was commenced in Los Angeles County. The case was tried before Judge Clair S.

Tappaan, who rendered judgment for the defendant. Subsequently motion for a new trial was made which was denied.

People vs. *Van Camp Seafood Company.* Same as previous case.

Barnes vs. *Stevenot et al.* This is a mandamus action commenced by a former deputy of the division in the superior court of Humboldt County to recover the sum of $750 alleged to be due for past salary and expenses. The division moved to change the venue of the action to San Francisco County, which was granted, and since then plaintiff has not taken further steps to prosecute the case. The matter is still pending.

Svenson vs. *Engelke et al.* This suit was commenced in the superior court of Humboldt County by a group of Eureka fishermen to prevent the division and its deputies from arresting and interfering with them while bringing fresh salmon caught in the high seas over and across certain fish and game districts, closed to the possession of salmon, into the city of Eureka. The court granted the plaintiffs' preliminary injunction, from which the division appealed. The matter is now pending in the Supreme Court.

People vs. *Hutchinson et al.* This action was commenced in the superior court of Sacramento County to enforce the installation of a fish ladder to permit fish to pass over and around the dam of defendants. The action is awaiting trial.

Lenk vs. *Sibeck.* Suit to recover damages in the superior court of Sacramento County arising from the shooting of the plaintiff by one of the deputies of the division. The case was tried before Judge Peter J. Shields of Sacramento, who awarded damages to the extent of $3,000.

People vs. *Toyo Fisheries Company.* This action was commenced in Sacramento County to recover delinquent taxes under the Fisheries Tax and Regulation Act. Judgement was rendered in favor of the people.

In re Bryce Florence. This is a petition for writ of *habeas corpus* instituted in the superior court at San Francisco to secure the release from arrest for a violation of section 628 of the Penal Code. The case involved the question of the right of petitioner to ship abalone shells in an unmanufactured condition out of the state. The writ was denied and petitioner remanded.

People vs. *Ventura Packing Corporation.* This is a proceeding instituted in Ventura County to enjoin the defendant from using an excessive amount of sardines in its reduction plant. The action was dismissed on stipulation when the defendant shut down its plant and ceased operations for a period of two weeks.

Ventura Packing Corporation vs. *Zellerbach et al.* This was an action for injunction instituted in the superior court at Ventura to prevent the Fish and Game Commissioners from suspending the license of the plaintiff corporation to pack fish. The action was dismissed when the plaintiff accepted the suspension of its license.

People vs. *Cain Irrigation Co.* This case comes to the superior court on appeal from the judgment of conviction in the justice court at Bridgeport, Mono County. The defendant was convicted of wilful and

unlawful failure to install a fish ladder to permit fish to pass over and around its dam at Grant Lake. The matter is still pending.

People vs. *Stagnero.* This case comes to the superior court on appeal from the judgment of conviction in the justice court at San Luis Obispo. The matter is still pending.

CONDEMNATION OF NETS

Under section 636a of the Penal Code it is the duty of the division to institute proceedings of condemnation of nets seized by violation of the fish laws. These actions are brought in the superior courts. In compliance with this section the Commission started one hundred four separate proceedings. In each instance, except as to those cases now pending, judgment of condemnation was obtained.

HEARINGS

In accordance with various fish and game statutes the division is obliged to conduct and hold hearings to determine facts incidental to the regulation of fish and game; such as the necessity of fish screens or fish ladders, the feasibility of issuing permits and so forth. At all these hearings the division is represented by the legal department. Thirty-one hearings were held for the Commercial Fisheries Department of the division and two hearings were held on fish screen and ladder matters.

APPENDIX

STATISTICAL REPORTS

STATEMENT OF INCOME FOR THE PERIOD JULY 1, 1928 TO JUNE 30, 1929

80th Fiscal Year

	Division of Fish and Game	County Clerks	Total
Hunting, 1928	$246,926 00	$214,486 50	$461,412 50
Hunting, 1929	26,203 00	14,186 00	40,389 00
Angling, 1927		1,040 00	1,040 00
Angling, 1928	178,926 00	191,388 20	370,314 20
Angling, 1929	51,425 00	22,478 00	73,903 00
Deer tags, 1928	48,241 00	57,393 80	105,634 80
Trapping, 1928-29	6,040 00	439 00	6,479 00
Market fishermen, 1928-29	31,320 00		31,320 00
Market fishermen, 1929-30	30,970 00		30,970 00
Fish packers, 1928-29	990 00		990 00
Game breeders, 1928	102 50		102 50
Game breeders, 1929	717 50		717 50
Fish breeders, 1928	55 00		55 00
Fish breeders, 1929	335 00		335 00
Hunting club, 1928-29	2,025 00		2,025 00
Hunting club, 1929-30	25 00		25 00
Hunting club operators, 1928-29	575 00		575 00
Kelp	10 00		10 00
Total license sales	$624,886 00	$501,411 50	$1,126,297 50
		Judges	
Fish packers tax	$175,805 85		$175,805 85
Fish tag sales	7,047 63		7,047 63
Kelp tax	50 28		50 28
Interest	5,170 21		5,170 21
Game tag sales	37 56		37 56
Importers' contributions	428 18		428 18
Miscellaneous sales	699 89		699 89
Court fines		$86,780 28	86,780 28
Total miscellaneous collections	$189,239 60	$86,780 28	$276,019 88
Total income	$814,125 60	$588,191 78	$1,402,317 38

STATEMENT OF INCOME FOR THE PERIOD JULY 1, 1929 TO JUNE 30, 1930

81st Fiscal Year

	Division of Fish and Game	County Clerks	Total
Hunting, 1929	$247,435 00	$200,288 97	$447,732 97
Hunting, 1930	13,606 00	10,607 90	24,213 90
Angling, 1929	214,034 00	181,503 85	395,537 85
Angling, 1930	65,336 00	14,335 90	79,671 90
Deer tags, 1929	56,283 00	59,188 80	115,471 80
Market, 1929-30	29,170 00		29,170 00
Market, 1930-31	32,110 00		32,110 00
Trapping, 1929-30	3,865 00	573 00	4,438 00
Game breeders, 1929	105 00		105 00
Game breeders, 1930	827 50		827 50
Fish breeders, 1929	75 00		75 00
Fish breeders, 1930	425 00		425 00
Fish importers, 1929	55 00		55 00
Fish importers, 1930	95 00		95 00
Fish packers, 1928-29	20 00		20 00
Fish packers, 1929-30	1,320 00		1,320 00
Commercial hunting club, 1929-30	2,550 00		2,550 00
Commercial hunting club operators, 1929-30	820 00		820 00
Kelp, 1929	10 00		10 00
Kelp, 1930	50 00		50 00
Total license sales	$668,191 50	$466,498 42	$1,134,689 92
		Judges	
Kelp tax	$105 97		$105 97
Fish tag sales	3,398 84		3,398 84
Fish packers' tax	202,396 07		202,396 07
Interest	5,191 20		5,191 20
Game tag sales	51 69		51 69
Miscellaneous sales	1,005 44	$21 68	1,027 12
Court fines		84,872 40	84,872 40
Total miscellaneous collections	$212,149 21	$84,894 08	$297,043 29
Total income	$880,340 71	$551,392 50	$1,431,733 21

STATEMENT OF EXPENDITURES FOR THE PERIOD JULY 1, 1928 TO JUNE 30, 1929

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Administration—					
Executive and legal	$16,109 99	$2 90	$3,114 19	$571 65	$19,798 73
Clerical and office	23,475 03	1,234 83	5,286 83	580 10	30,576 79
Rent			9,045 88		9,045 88
Automobiles		289 70	356 44		646 14
Telephone and telegraph			5,006 57		5,006 57
Postage			4,121 66		4,121 66
Freight, cartage and express			2,210 23		2,210 23
Printing		12,189 80			12,189 80
Accident and death claims			8,423 43		8,423 43
Commissioners			637 12		637 12
Total administration	$39,585 02	$13,717 23	$38,204 35	$1,151 75	$92,658 35
Education—					
Director and assistants	$13,932 56	$688 94	$3,851 92	$2,418 22	$20,891 64
Pacific Southwest Exposition	248 75	1,014 06	1,349 13		2,611 94
Total education	$14,181 31	$1,703 00	$5,201 05	$2,418 22	$23,503 58
Publicity—					
Director	$3,300 00		$693 14		$3,993 14
State Fair	357 00	$212 21	730 71		1,299 92
Total publicity	$3,657 00	$212 21	$1,423 85		$5,293 06
Conservation and protection—					
Chief and assistants	$10,700 02	$39 55	$2,233 84		$12,973 41
Clerical and office	2,875 00	66 86		$10 50	2,952 36
Rent			381 19		381 19
Automobiles		993 58	615 30	6,474 02	8,082 90
Captains and deputies	211,017 26	254 08	156,513 32	840 46	368,625 12
Patrol launches	2,085 00	1,591 73	1,807 11	488 61	5,972 45
Lion hunters	3,968 69				3,968 69
Coyote trappers	358 88				358 88
Lion bounties			8,500 00		8,500 00
Fish planting	1,385 00	1,016 75	2,324 51		4,726 26
Refuge posting	6,111 78	366 19	1,246 32	35 78	7,760 07
Fish reclamation and rescue	505 00		458 22		963 22
Total conservation and protection	$239,006 63	$4,328 74	$174,079 81	$7,849 37	$425,264 55
Commercial fisheries—					
Chief and assistants	$9,691 34	$798 07	$2,197 21	$499 71	$13,186 33
Deputies	32,751 77	110 17	9,141 52	65 53	42,068 99
Patrol launches	3,321 45	2,378 46	2,290 04	97 48	8,087 43
Statistical	7,395 00	240 40	744 40		8,379 80
Laboratory	35,954 06	1,567 51	7,172 44	958 41	45,652 42
Salmon tagging		224 34	41 00		265 34
Botulism			15,000 00		15,000 00
Automobiles		491 23	301 17		792 40
Carp eradication	1,485 84	315 10	240 35		2,041 29
Biological survey of Monterey Bay			1,500 00		1,500 00
Total commercial fisheries	$90,599 46	$6,125 28	$38,628 13	$1,621 13	$136,974 00
Fish culture—					
Chief and assistants	$4,730 00	$8 18	$469 87	$26 50	$5,234 55
Clerical and office	3,990 67	82 48	314 43	153 65	4,541 23
Rent			105 00		105 00
Automobiles		3,564 53	1,658 21	52 55	5,275 29
Hatcheries	12,878 31	62,853 37	18,597 89	7,168 63	217,498 20
Hatcheries, additions and betterments				2,070 02	2,070 02
Special field investigation	9,060 00	1 50	3,716 06	7 18	12,784 74
Fish reclamation and rescue	3,271 00	327 31	1,126 13	176 87	4,901 31
Total fish culture	$149,929 98	$66,837 37	$25,987 59	$9,655 40	$252,410 34
Hydraulics—					
Chief and assistants	$5,790 00	$441 60	$2,039 34	$176 72	$8,447 66
Cooperative research work	2,704 33		137 90		2,842 23
Total hydraulics	$8,494 33	$441 60	$2,177 24	$176 72	$11,289 89

STATEMENT OF EXPENDITURES FOR THE PERIOD JULY 1, 1928 TO JUNE 30, 1929—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Game propagation—					
Game farm, Yountville	$9,546 44	$8,527 84	$3,012 93	$2,097 44	$23,184 65
Automobiles		151 37	69 46		220 83
Southern California game farm			4 80		4 80
Southern California game farm additions and betterments				1,954 18	1,954 18
Total game propagation	$9,546 44	$8,679 21	$3,087 19	$4,051 62	$25,364 46
Research—					
Chief and assistants	$11,435 03	$592 72	$1,595 63	$70 00	$13,693 38
License commissions			$55,291 48		$55,291 48
Hungarian partridges				$5,678 30	$5,678 30
Salinas River channel				98 37	98 37
Totals, 80th fiscal year	$566,435 20	$102,637 36	$36,345,676 32	$32,770 88	$1,047,519 76
Prior year					5,418 61
Grand total					$1,052,938 37

STATEMENT OF EXPENDITURES

For the Period July 1, 1929, to June 30, 1930, of the Eighty-first Fiscal Year

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Total
Administration:					
Executive and legal	$16,820 00		$24 70	$15 40	$16,860 10
Clerical and office	18,283 90	$1,187 49	934 73	210 45	20,616 57
Printing		16,193 95			16,193 95
Automobiles		284 71	18 50		303 21
Traveling			4,884 55		4,884 55
Postage			4,591 51		4,591 51
Telephone and telegraph			4,732 23		4,732 23
Freight, cartage and express			2,206 20		2,206 20
Rent			15,328 61		15,328 61
Heat, light and power			305 59		305 59
Accident and death claims			5,234 25		5,234 25
Accounting pro rata	3,600 00				3,600 00
Legal			807 05	22 25	829 30
Publicity			362 18		362 18
Total administration	$38,703 90	$17,666 15	$39,430 10	$248 10	$96,048 25
Education and research:					
Chief and assistant	$7,761 94		$10 00	$6 46	$7,778 40
Clerical and office	1,292 00	$198 07	258 35	386 01	2,834 45
Traveling			3,828 26		3,828 26
Photographer	1,200 00		251 75	1,575 94	3,007 69
Librarian	1,920 00	97 82	59 29	371 34	2,448 45
Exhibits			40 00	75 00	115 00
Research	4,362 54	403 06		475 34	5,240 94
State fair	276 00	260 71	800 35		1,337 06
Lecturers	2,695 00				2,695 00
Printing		34 80			34 80
Freight, cartage and express			2 00		2 00
Blue printing			13 00		13 00
Publicity			100 93		100 93
Total education and research	$20,207 48	$994 46	$5,343 93	$2,890 09	$29,435 96
Publicity:					
Chief of Bureau	$1,650 00		$253 61		$1,903 61
Traveling			39 40		39 40
Total publicity	$1,650 00		$293 01		$1,943 01
Patrol and law enforcement:					
Chief and assistants	$12,095 00			$11 55	$12,106 55
Clerical and office	2,930 00	$160 81	$27 28		3,138 09
Automobiles		3,530 94	1,599 68	621 91	5,752 53
Traveling			141,218 97		141,218 97
Captains and deputies	$208,659 15	$929 35	$1,583 60	$748 00	$211,920 10
Fish planting	1,993 43	720 69	1,057 32	828 00	4,599 44
Watchman	60 00				60 00
Launches	2,040 00	1,269 16	619 42	965 00	4,893 58
Volunteer deputies	555 00	38 50	5 00		598 50
Premiums on bonds			4,843 41		4,843 41
Freight, cartage and express			4 77		4 77
Rent			417 91		417 91
Total patrol and law enforcement	$228,352 58	$8,649 45	$151,377 36	$3,174 46	$389,553 85
Commercial fisheries:					
Chief and assistants	$10,500 00			$7 47	$10,507 47
Clerical and office	8,976 89	$164 84	$62 09	34 45	9,238 27
Automobiles		386 85	89 12	506 02	901 99
Traveling			19,204 68		19,204 68
Research	6,529 83	8 25		302 70	6,840 76
Captains and deputies	15,058 03	165 50	34 57	117 34	15,375 44
Launches	5,674 47	3,494 42	3,204 25	277 76	12,650 90
Statistics	2,940 00	458 70			3,398 70
Laboratory	31,474 74	1,021 15	2,118 05	690 72	35,304 66
Fish tags		412 50			412 50
Botulism			15,000 00		15,000 00
Hydro-Biological Survey Monterey Bay			1,500 00		1,500 00
Inspectors	28,694 50				28,694 50
Temporary help	319 25				319 25
Postage			20 00		20 00
Freight, cartage and express			73 09		73 09
Heat, light and power			7 49		7 49
Total commercial fisheries	$110,167 71	$6,032 19	$41,313 34	$1,936 46	$159,449 70

STATEMENT OF EXPENDITURES

For the Period July 1, 1929, to June 30, 1930, of the Eighty-first Fiscal Year—Continued

Function	Salaries and wages	Materials and supplies	Service and expense	Property and equipment	Tota
Fish culture:					
Chief and assistants	$6,600 00				$6,600 00
Clerical and office	3,900 00	$65 82	$14 00	$5 05	$3,982 87
Automobiles		4,664 03	2,078 30	1,771 31	8,513 64
Traveling			13,445 51		13,445 51
Telephone and telegraph			850 82		850 82
Rent			1,152 85		1,152 85
Heat, light and power			905 70		905 70
Hatcheries	131,937 83	67,305 32	2,498 20	2,717 20	204,458 55
Hatcheries—additions and betterments				17,976 18	17,976 18
Special field investigations	11,758 00	61 61	233 08		12,052 69
Fish cars		262 78	2,304 79		2,567 57
Freight, cartage and express			1,429 53		1,429 53
Blue printing			17 00		17 00
Total fish culture	$154,195 83	$72,359 56	$24,929 78	$22,467 74	$273,952 91
Hydraulics:					
Chief and assistants	$6,060 00		$18 37		$6,078 37
Clerical and office		$51 78	28 73		80 51
Automobiles		498 70	146 40		645 10
Traveling			1,453 37		1,453 37
Cooperative research	2,459 55	2 10	38 25		2,500 00
Blue printing			30 93		30 93
Total hydraulics	$8,519 65	$552 58	$1,716 05		$10,788 28
Game propagation:					
Superintendents	$4,914 17				$4,914 17
Automobiles		$325 12	$48 49	$1,986 01	2,359 62
Traveling			2,269 98		2,269 98
Heat, light and power			787 65		787 65
Laborers	8,476 54				8,476 54
Maintenance		10,391 41	1,663 44	4,397 28	16,452 13
Telephone and telegraph			151 55		151 55
Freight, cartage and express			141 71		141 71
Total game propagation	$13,390 71	$10,716 53	$5,062 82	$6,383 29	$35,553 55
Fish rescue:					
Chief and assistants	$4,669 00	$3 69	$127 60	$4 10	$4,804 39
Traveling			1,867 48		1,867 48
Rent			129 00		129 00
Heat, light, water and power			9 00		9 00
Total fish rescue	$4,669 00	$3 69	$2,133 08	$4 10	$6,809 87
Game refuge:					
Chief and assistants	$4,000 00				$4,000 00
Clerical and office	1,800 00	$5 27	$1 25		1,806 52
Automobiles		511 47	307 62		819 09
Traveling			1,305 22		1,305 22
Lion hunters and trappers	7,661 79				7,661 79
Refuge posting	2,962 71	73 33	49 92		3,985 96
Game refuge supplies		177 92	44 37		222 29
Lion bounties			6,710 00		6,710 00
Total game refuge	$16,424 50	$767 99	$8,418 38		$25,610 87

STATEMENT OF EXPENDITURES

For the Period July 1, 1929, to June 30, 1930, of the Eighty-first Fiscal Year—Continued

Function	Service and expense	Total
License commissions	$49,961 41	$49,961 41
Purchase of game refuges		4,558 98
Purchase of Hungarian partridges		4,759 73
Construction of Russian River jetties		17,750 00
Expenditures to pay claims for returns of fish and game licenses		83 50
Expenditure to pay claim of Harry L. Hopper		658 50
Prior year		192,988 70
Grand totals	$49,961 41	$1,299,906 87

STATEMENT OF INCOME

For the Period July 1, 1929, to June 30, 1929, of the Eighty-first Fiscal Year

License sales	Detail	Total
Angling, 1929	$395,537 95	
Angling, 1930	79,671 90	
Commercial hunting club licenses, 1929-30	2,550 00	
Commercial hunting club operators' licenses, 1929-30	820 00	
Deer tag licenses, 1929	115,471 80	
Fish breeders' licenses, 1929	75 00	
Fish breeders' licenses, 1930	425 00	
Fish importers' licenses, 1929	55 00	
Fish importers' licenses, 1930	95 00	
Game breeders' licenses, 1929	195 00	
Game breeders' licenses, 1930	827 50	
Hunting licenses, 1929	447,723 87	
Hunting licenses, 1930	24,213 90	
Kelp licenses, 1929	10 00	
Kelp licenses, 1930	50 00	
Market fishermen's licenses, 1929-30	29,170 00	
Market fishermen's licenses, 1930-31	32,110 00	
Trapping licenses, 1929-30	4,438 00	
Wholesale fish packers' and shell fish dealers' licenses, 1929-30	1,320 00	
Wholesale fish packers' and shell fish dealers' licenses, 1928-29	20 00	
Total license sales		$1,134,689 92
Other income:		
Game tag sales	$51 69	
Court fines	84,872 40	
Fish packers' tax	202,596 07	
Kelp tax	105 97	
Fish tag sales	3,398 84	
Miscellaneous sales	1,027 12	
Interest on bank balances	5,191 20	
Total other income		297,043 29
Total departmental income		$1,431,733 21

HUNTING LICENSE SALES

Year 1928

County	Total	Citizen	Citizen (boys)	Non-resident	Alien	Declarant-alien
Alameda	$22,811 00	$21,982 00	$324 00		$225 00	$280 00
Alpine	175 00	100 00	5 00	$70 00		
Amador	1,614 00	1,528 00	46 00	10 00		30 00
Butte	8,514 00	7,966 00	433 00	40 00	25 00	50 00
Calaveras	1,582 00	1,498 00	84 00			
Colusa	3,917 00	3,678 00	179 00	30 00		30 00
Contra Costa	6,120 00	5,722 00	188 00		100 00	110 00
Del Norte	1,519 00	1,376 00	33 00	10 00	50 00	50 00
El Dorado	2,563 00	2,338 00	105 00	30 00	50 00	40 00
Fresno	17,052 00	15,940 00	877 00		125 00	110 00
Glenn	3,406 00	3,060 00	196 00	60 00	50 00	40 00
Humboldt	10,157 00	9,522 00	275 00		200 00	160 00
Imperial	2,796 00	2,482 00	54 00	100 00	150 00	10 00
Inyo	3,305 00	5,128 00	152 00		25 00	
Kern	12,662 00	12,154 00	353 00	20 00	125 00	10 00
Kings	2,807 00	2,648 00	159 00			
Lake	3,546 00	3,404 00	97 00	10 00	25 00	10 00
Lassen	3,957 00	3,522 00	195 00	100 00		140 00
Los Angeles	89,376 00	86,310 00	2,376 00	180 00	300 00	210 00
Madera	2,399 00	2,198 00	101 00			100 00
Marin	3,439 00	3,270 00	169 00			
Mariposa	627 00	602 00	25 00			
Mendocino	3,426 00	3,110 00	196 00	10 00		110 00
Merced	5,545 00	5,104 00	231 00		150 00	60 00
Modoc	10,026 00	2,638 00	178 00	7,210 00		
Mono	814 00	752 00	42 00	20 00		
Monterey	7,476 00	6,926 00	255 00	10 00	75 00	210 00
Napa	4,667 00	4,132 00	275 00	10 00	50 00	200 00
Nevada	2,526 00	2,338 00	88 00	40 00	50 00	10 00
Orange	8,215 00	7,862 00	333 00			20 00
Placer	5,173 00	4,482 00	256 00	70 00	75 00	290 00
Plumas	2,880 00	2,774 00	56 00	10 00		40 00
Riverside	7,244 00	6,920 00	289 00		25 00	10 00
Sacramento	14,398 00	13,212 00	521 00	70 00	225 00	370 00
San Benito	2,271 00	1,984 00	207 00			80 00
San Bernardino	8,713 00	8,336 00	342 00		25 00	10 00
San Diego	16,393 00	15,486 00	712 00	20 00	125 00	50 00
San Francisco	31,514 00	27,676 00	438 00	150 00	1,000 00	2,250 00
San Joaquin	11,765 00	10,968 00	527 00			270 00
San Luis Obispo	5,441 00	5,010 00	311 00	40 00	50 00	30 00
San Mateo	4,754 00	4,212 00	262 00		50 00	230 00
Santa Barbara	6,860 00	6,562 00	148 00		100 00	50 00
Santa Clara	13,334 00	12,144 00	825 00		125 00	240 00
Santa Cruz	5,252 00	4,508 00	289 00	20 00	125 00	310 00
Shasta	4,407 00	4,160 00	157 00	30 00		60 00
Sierra	517 00	490 00	17 00	10 00		
Siskiyou	14,990 00	8,570 00	385 00	5,580 00	125 00	330 00
Solano	5,196 00	4,906 00	245 00		25 00	20 00
Sonoma	12,075 00	11,256 00	294 00		125 00	400 00
Stanislaus	7,426 00	6,846 00	470 00	10 00		100 00
Sutter	1,669 00	1,446 00	68 00		75 00	80 00
Tehama	3,275 00	3,122 00	98 00	10 00	25 00	20 00
Trinity	940 00	920 00	20 00			
Tulare	9,369 00	8,772 00	557 00	10 00		30 00
Tuolumne	2,553 00	2,444 00	99 00			10 00
Ventura	7,739 00	7,160 00	419 00		100 00	60 00
Yolo	3,829 00	3,600 00	179 00			50 00
Yuba	3,702 00	3,466 00	216 00			20 00
Oregon	2,837 00	600 00	17 00	2,220 00		
Nevada	590 00			590 00		
Total sales	$464,145 00	$419,322 00	$16,448 00	$16,800 00	$4,175 00	$7,400 00
Total number of licenses	228,696	209,661	16,448	1,680	167	740

HUNTING LICENSE SALES

Year 1929

County	Total	Citizen	Citizen (junior)	Non-resident	Alien	Declarant-alien
Alameda	$23,551 00	$22,606 00	$505 00	$10 00	$200 00	$230 00
Alpine	223 00	110 00	3 00	110 00	----------	----------
Amador	1,471 00	1,370 00	71 00	----------	----------	30 00
Butte	8,922 00	8,224 00	538 00	60 00	50 00	50 00
Calaveras	1,655 00	1,550 00	105 00	----------	----------	----------
Colusa	4,399 00	4,074 00	270 00	10 00	25 00	20 00
Contra Costa	6,979 00	6,344 00	380 00	----------	125 00	130 00
Del Norte	1,609 00	1,380 00	74 00	40 00	75 00	40 00
El Dorado	2,692 00	2,474 00	108 00	40 00	50 00	20 00
Fresno	18,010 00	16,786 00	1,074 00	----------	50 00	100 00
Glenn	3,648 00	3,314 00	209 00	20 00	75 00	30 00
Humboldt	10,089 00	9,242 00	417 00	20 00	200 00	210 00
Imperial	3,341 00	3,256 00	65 00	----------	----------	20 00
Inyo	2,001 00	1,796 00	150 00	20 00	25 00	10 00
Kern	13,811 00	13,134 00	582 00	----------	75 00	20 00
Kings	2,716 00	2,518 00	198 00	----------	----------	----------00
Lake	3,457 00	3,238 00	189 00	10 00	----------	20 00
Lassen	4,294 00	3,692 00	272 00	130 00	50 00	150 00
Los Angeles	97,014 00	93,694 00	2,525 00	180 00	325 00	290 00
Madera	2,617 00	2,394 00	138 00	----------	25 00	60 00
Marin	3,492 00	3,252 00	240 00	----------	----------	----------
Mariposa	421 00	398 00	23 00	----------	----------	----------00
Mendocino	6,090 32	5,726 32	254 00	10 00	50 00	50 00
Merced	6,419 00	5,818 00	376 00	10 00	125 00	90 00
Modoc	9,656 00	3,380 00	206 00	6,060 00	----------	10 00
Mono	1,033 00	856 00	37 00	140 00	----------	----------
Monterey	7,703 00	6,998 00	350 00	----------	225 00	130 --
Napa	4,901 00	4,348 00	283 00	----------	100 00	170 00
Nevada	2,468 00	2,128 00	100 00	50 00	150 00	40 00
Orange	8,545 00	8,120 00	380 00	10 00	25 00	10 00
Placer	5,142 00	4,572 00	280 00	90 00	50 00	150 --
Plumas	3,031 00	2,896 00	70 00	10 00	25 00	30 00
Riverside	6,825 00	6,424 00	371 00	10 00	----------	20 00
Sacramento	14,664 00	13,232 00	617 00	30 00	325 00	460 00
San Benito	2,353 00	2,048 00	215 00	----------	----------	90 00
San Bernardino	9,025 00	8,634 00	366 00	----------	25 00	----------
San Diego	16,771 00	15,646 00	975 00	20 00	100 00	30 00
San Francisco	31,739 00	27,368 00	711 00	90 00	1,200 00	2,370 00
San Joaquin	12,226 00	11,354 00	712 00	10 00	----------	150 00
San Luis Obispo	5,986 00	5,510 00	411 00	30 00	25 00	10 00
San Mateo	4,999 00	4,322 00	367 00	10 00	150 00	150 00
Santa Barbara	6,844 00	6,458 00	271 00	----------	75 00	40 00
Santa Clara	12,831 00	11,666 00	710 00	----------	75 00	380 00
Santa Cruz	5,407 00	4,538 00	399 00	----------	150 00	320 00
Shasta	4,569 00	4,276 00	243 00	10 00	----------	40 00
Sierra	618 00	556 00	17 00	10 00	25 00	10 00
Siskiyou	10,465 00	8,034 00	396 00	1,590 00	75 00	370 00
Solano	5,986 00	5,656 00	320 00	----------	----------	10 00
Sonoma	11,459 00	10,538 00	436 00	10 00	175 00	300 00
Stanislaus	8,040 00	7,336 00	579 00	10 00	25 00	90 00
Sutter	1,329 00	1,142 00	92 00	----------	25 00	70 00
Tehama	3,063 00	2,910 00	103 00	30 00	----------	20 00
Trinity	876 00	858 00	18 00	----------	----------	----------
Tulare	9,887 00	9,292 00	555 00	----------	----------	40 00
Tuolumne	2,480 00	2,384 00	86 00	----------	----------	10 00
Ventura	8,308 00	7,704 00	544 00	----------	----------	60 00
Yolo	4,094 00	3,770 00	284 00	10 00	----------	30 00
Yuba	3,865 00	3,606 00	249 00	----------	----------	10 00
Oregon	11,275 00	1,120 00	15 00	10,140 00	----------	----------
Nevada	730 00	----------	----------	730 00	----------	----------
Total sales	$488,114 32	$436,070 32	$20,534 00	$19,770 00	$4,550 00	$7,190 00
Total number of licenses	241,447	218,035	20,534	1,977	182	719

ANGLING LICENSE SALES

Year 1928

County	Total	Citizen	Non-resident	Alien
Alameda	$31,351 00	$30,580 00	$21 00	$750 00
Alpine	630 00	264 00	366 00	------------
Amador	1,643 00	1,608 00	------------	35 00
Butte	7,925 00	7,714 00	36 00	175 00
Calaveras	1,588 00	1,580 00	3 00	5 00
Colusa	1,416 00	1,386 00	------------	30 00
Contra Costa	6,994 00	6,826 00	3 00	165 00
Del Norte	2,183 00	2,040 00	123 00	20 00
El Dorado	3,738 00	3,572 00	66 00	100 00
Fresno	18,299 00	17,548 00	21 00	730 00
Glenn	1,405 00	1,402 00	3 00	------------
Humboldt	11,392 00	11,144 00	63 00	185 00
Imperial	1,169 00	1,034 00	120 00	15 00
Inyo	9,414 00	9,234 00	60 00	120 00
Kern	6,875 00	6,860 00	15 00	------------
Kings	1,805 00	1,724 00	6 00	75 00
Lake	2,660 00	2,634 00	21 00	5 00
Lassen	4,411 00	4,210 00	96 00	105 00
Los Angeles	73,394 00	72,476 00	123 00	795 00
Madera	2,427 00	2,404 00	3 00	20 00
Marin	3,950 00	3,950 00	------------	------------
Mariposa	3,125 00	2,982 00	108 00	35 00
Mendocino	3,050 00	2,930 00	------------	120 00
Merced	3,327 00	3,290 00	12 00	25 00
Modoc	1,881 00	1,810 00	66 00	5 00
Mono	3,090 00	2,628 00	402 00	60 00
Monterey	5,498 00	5,242 00	6 00	250 00
Napa	4,744 00	4,664 00	15 00	65 00
Nevada	3,802 00	3,518 00	129 00	155 00
Orange	5,031 00	5,006 00	------------	25 00
Placer	5,062 00	4,728 00	54 00	280 00
Plumas	5,197 00	4,960 00	87 00	150 00
Riverside	4,325 00	4,280 00	------------	45 00
Sacramento	18,631 00	15,874 00	102 00	2,655 00
San Benito	724 00	704 00	------------	20 00
San Bernardino	13,505 00	13,444 00	6 00	55 00
San Diego	13,690 00	13,516 00	144 00	30 00
San Francisco	42,165 00	39,126 00	84 00	2,955 00
San Joaquin	13,151 00	12,202 00	9 00	940 00
San Luis Obispo	2,528 00	2,478 00	------------	50 00
San Mateo	3,366 00	3,236 00	------------	130 00
Santa Barbara	4,406 00	4,306 00	------------	100 00
Santa Clara	11,986 00	11,720 00	6 00	260 00
Santa Cruz	5,494 00	5,316 00	3 00	175 00
Shasta	4,813 00	4,734 00	24 00	55 00
Sierra	679 00	638 00	6 00	35 00
Siskiyou	9,812 00	9,032 00	225 00	555 00
Solano	6,324 00	5,664 00	------------	660 00
Sonoma	11,761 00	11,494 00	12 00	255 00
Stanislaus	7,684 00	7,578 00	6 00	100 00
Sutter	1,724 00	1,676 00	3 00	45 00
Tehama	2,937 00	2,900 00	27 00	10 00
Trinity	748 00	742 00	6 00	------------
Tulare	8,484 00	8,390 00	39 00	55 00
Tuolumne	3,606 00	3,550 00	6 00	50 00
Ventura	5,446 00	5,332 00	9 00	105 00
Yolo	1,999 00	1,906 00	3 00	90 00
Yuba	2,659 00	2,536 00	3 00	120 00
Oregon	29 00	20 00	9 00	------------
Nevada	2,508 00	------------	2,508 00	------------
Total sales	$443,660 00	$424,342 00	$5,268 00	$14,050 00
Total number of licenses	216,736	212,171	1,755	2,810

ANGLING LICENSE SALES

Year 1929

Counties	Total	Citizen	Non-resident	Alien
Alameda	$34,030 00	$33,196 00	$24 00	$810 00
Alpine	467 00	198 00	264 00	5 00
Amador	1,648 00	1,618 00		30 00
Butte	8,320 00	8,202 00	18 00	100 00
Calaveras	1,566 00	1,566 00		
Colusa	1,380 00	1,372 00	3 00	5 00
Contra Costa	8,724 00	8,466 00	3 00	255 00
Del Norte	2,646 00	2,468 00	153 00	25 00
El Dorado	3,373 00	3,210 00	63 00	100 00
Fresno	18,307 00	17,640 00	27 00	640 00
Glenn	1,512 00	1,504 00	3 00	5 00
Humboldt	11,743 00	11,406 00	57 00	280 00
Imperial	1,433 00	1,262 00	171 00	
Inyo	9,035 00	8,944 00	21 00	70 00
Kern	7,253 00	7,230 00	3 00	20 00
Kings	1,336 00	1,306 00		30 00
Lake	2,648 00	2,628 00	15 00	5 00
Lassen	4,436 00	4,202 00	144 00	90 00
Los Angeles	82,175 00	81,028 00	132 00	1,015 00
Madera	2,410 00	2,396 00	9 00	5 00
Marin	4,374 00	4,374 00		
Mariposa	2,699 00	2,516 00	168 00	15 00
Mendocino	3,602 20	3,460 20	12 00	130 00
Merced	3,429 00	3,388 00	6 00	35 00
Modoc	2,374 00	2,312 00	57 00	5 00
Mono	4,458 00	3,866 00	507 00	85 00
Monterey	5,350 00	5,038 00	42 00	270 00
Napa	4,811 00	4,792 00	9 00	10 00
Nevada	3,931 00	3,638 00	123 00	170 00
Orange	5,854 00	5,824 00		30 00
Placer	5,341 00	5,032 00	54 00	255 00
Plumas	5,849 00	5,594 00	105 00	150 00
Riverside	4,506 00	4,450 00	6 00	50 00
Sacramento	19,227 00	16,112 00	60 00	3,055 00
San Benito	775 00	730 00		45 00
San Bernardino	13,042 00	12,968 00	9 00	65 00
San Diego	16,224 00	15,918 00	231 00	75 00
San Francisco	45,254 00	42,120 00	99 00	3,035 00
San Joaquin	13,186 00	12,550 00	6 00	630 00
San Luis Obispo	2,630 00	2,554 00	6 00	70 00
San Mateo	3,748 00	3,620 00	3 00	125 00
Santa Barbara	4,040 00	3,938 00	12 00	90 00
Santa Clara	11,455 00	11,164 00	6 00	285 00
Santa Cruz	5,854 00	5,206 00	18 00	630 00
Shasta	4,941 00	4,854 00	27 00	60 00
Sierra	1,044 00	992 00	12 00	40 00
Siskiyou	10,433 00	9,486 00	402 00	545 00
Solano	6,568 00	6,078 00		490 00
Sonoma	12,169 00	11,898 00	6 00	265 00
Stanislaus	8,213 00	8,076 00	12 00	125 00
Sutter	1,178 00	1,122 00	6 00	50 00
Tehama	2,841 00	2,820 00	21 00	
Trinity	744 00	744 00		
Tulare	8,273 00	8,170 00	48 00	55 00
Tuolumne	3,414 00	3,342 00	12 00	60 00
Ventura	6,224 00	6,136 00	3 00	85 00
Yolo	2,120 00	2,034 00	6 00	80 00
Yuba	2,467 00	2,358 00	9 00	100 00
Oregon	78 00	48 00	30 00	
Nevada	2,280 00		2,280 00	
Total sales	$469,442 20	$449,164 20	$5,523 00	$14,755 00
Total number of licenses	229,374	224,582	1,841	2,951

DEER TAG LICENSE SALES, BY COUNTIES

Years, 1927-1928-1929

County	1927	1928	1929
Alameda	$5,101 00	$4,947 00	$5,263 00
Alpine	32 00	34 00	52 00
Amador	452 00	446 00	433 00
Butte	2,902 00	2,643 00	2,770 00
Calaveras	591 00	585 00	606 00
Colusa	1,184 00	1,149 00	1,263 00
Contra Costa	1,253 00	1,248 00	1,395 00
Del Norte	414 00	445 00	426 00
El Dorado	1,180 00	1,098 00	1,195 00
Fresno	3,324 00	3,153 00	3,616 00
Glenn	1,117 00	1,160 00	1,178 00
Humboldt	3,792 00	3,809 00	3,756 00
Imperial	129 00	128 00	179 00
Inyo	852 00	865 00	796 00
Kern	3,128 00	3,248 00	3,584 00
Kings	334 00	409 00	434 00
Lake	1,652 00	1,611 00	1,681 00
Lassen	1,443 00	1,384 00	1,618 00
Los Angeles	13,879 00	11,606 00	15,087 00
Madera	711 00	658 00	674 00
Marin	1,088 00	1,157 00	1,183 00
Mariposa	216 00	206 00	160 00
Mendocino	3,032 00	2,908 00	3,073 00
Merced	893 00	769 00	917 00
Modoc	1,137 00	1,326 00	1,659 00
Mono	124 00	153 00	227 00
Monterey	2,412 00	2,482 00	2,674 00
Napa	1,769 00	1,845 00	1,952 00
Nevada	848 00	691 00	687 00
Orange	1,224 00	1,116 00	1,522 00
Placer	1,675 00	1,864 00	1,930 00
Plumas	1,307 00	1,247 00	1,401 00
Riverside	1,458 00	921 00	1,372 00
Sacramento	3,367 00	3,344 00	3,032 00
San Benito	828 00	781 00	846 00
San Bernardino	1,483 00	1,237 00	1,756 00
San Diego	2,078 00	1,948 00	2,006 00
San Francisco	5,963 00	5,803 00	5,971 00
San Joaquin	2,009 00	2,099 00	1,952 00
San Luis Obispo	1,887 00	1,793 00	2,044 00
San Mateo	979 00	1,078 00	1,179 00
Santa Barbara	2,353 00	1,861 00	2,005 00
Santa Clara	3,722 00	3,608 00	3,733 00
Santa Cruz	1,351 00	1,354 00	1,442 00
Shasta	1,990 00	1,894 00	1,962 00
Sierra	269 00	214 00	229 00
Siskiyou	4,234 00	3,969 00	3,731 00
Solano	1,374 00	1,448 00	1,605 00
Sonoma	4,612 00	4,402 00	4,261 00
Stanislaus	1,431 00	1,549 00	1,574 00
Sutter	346 00	344 00	344 00
Tehama	1,490 00	1,399 00	1,429 00
Trinity	482 00	418 00	429 00
Tulare	2,475 00	2,282 00	2,677 00
Tuolumne	976 00	915 00	948 00
Ventura	1,741 00	2,245 00	2,470 00
Yolo	1,433 00	1,165 00	1,412 00
Yuba	1,079 00	956 00	1,125 00
Nevada (state of)	33 00	60 00	80 00
Oregon (state of)	122 00	150 00	467 00
Total sales	$110,760 00	$105,638 00	$115,472 00

MARKET FISHERMEN'S LICENSE SALES

Total sales, license year April 1, 1928, to March 31, 1929	$53,400 00
Total sales, license year April 1, 1929, to March 31, 1930	60,140 00

License fee: All persons, $10.

TRAPPING LICENSE SALES

Total sales, license year July 1, 1928, to June 30, 1929	$6,581 00
Total sales, license year July 1, 1929, to June 30, 1930	4,438 00

License fee: Citizens, $1; aliens, $2.

FISH PACKERS' AND WHOLESALE SHELL-FISH DEALERS' LICENSE SALES

Total sales, license year July 1, 1928, to June 30, 1929	$1,180 00
Total sales, license year July 1, 1929, to June 30, 1930	1,325 00

License fee: Citizens, $5; aliens, $20.

GAME BREEDERS' LICENSE SALES

Total sales, license year January 1, 1928, to December 31, 1928	$677 50
Total sales, license year January 1, 1929, to December 31, 1929	822 50

License fee: All persons, $2.50.

FISH BREEDERS' LICENSE SALES

Total sales, license year January 1, 1928, to December 31, 1928	$270 00
Total sales, license year January 1, 1929, to December 31, 1929	410 00

License fee: All persons, $5.

DOMESTICATED FISH IMPORTERS' LICENSE SALES

Total sales, license year January 1, 1929, to December 31, 1929	$55 00

License fee: All persons, $5.

KELP LICENSE SALES

Total sales, year 1928	$20 00
Total sales, year 1929	20 00

License for term of one year from date of issuance. Fee, $10.

COMMERCIAL HUNTING GUN CLUB LICENSE SALES

Total sales, year July 1, 1928, to June 30, 1929	$2,025 00
Total sales, year July 1, 1929, to June 30, 1930	2,575 00

License fee: Citizens, $25; aliens, $100.

COMMERCIAL HUNTING CLUB OPERATORS' LICENSE SALES

Total sales, year July 1, 1928, to June 30, 1929	$575 00
Total sales, year July 1, 1929, to June 30, 1930	820 00

ARRESTS AND CONVICTIONS

RECAPITULATION

	Number of arrests	Fines and forfeitures imposed	Jail sentences (days)
Fish cases, 1928-1929	1,423	$43,330 50	1,365
Game cases, 1928-1929	1,265	46,493 00	2,432
Totals, 1928-1929	2,688	$89,823 50	3,797
Fish cases, 1929-1930	1,566	$42,777 00	775½
Game cases, 1929-1930	1,134	40,785 00	2,815
Totals, 1929-1930	2,700	$83,562 00	3,590½
Recapitulation—			
1928-1929	2,688	$89,823 50	3,797
1929-1930	2,700	83,562 00	3,590½
Totals	5,388	$173,385 50	7,387½

TOTAL ARRESTS FOR A PERIOD OF TWENTY-EIGHT YEARS

1902–1904	550
1904–1906	774
1906–1908	1,192
1908–1910	1,771
1910–1912	2,063
1912–1914	1,993
1914–1916	2,087
1916–1918	1,797
1918–1920	1,891
1920–1922	2,258
1922–1924	2,715
1924–1926	3,207
1926–1928	4,390
1928–1930	5,388

FISH CASES

	July 1, 1928, to June 30, 1929			July 1, 1929, to June 30, 1930		
	Number of arrests	Fines and forfeitures imposed	Jail sentence (days)	Number of arrests	Fines and forfeitures imposed	Jail sentence (days)
Violations, Angling License Act	248	$4,072 00	99½	208	$5,080 00	100
Violations, Commercial Fish License Act	78	1,690 00	420	164	3,147 00	20
Trout—taking and possession, closed season; other than hook and line; over bag limit; offering for sale	134	3,631 50	56	145	3,885 00	------
Striped Bass—closed season sale; undersized; over bag limit; shipment out of state	107	3,645 00	25	79	2,385 00	25
Black Bass—taking and possession; closed season; over bag limit	47	1,090 00	20	56	1,085 00	------
Sunfish, perch, crappie, calico bass—taking and possession, closed season	18	440 00	------	52	1,295 00	------
Catfish—sale of undersized	2	275 00	------	1	50 00	------
Salmon—closed season; over bag limit; illegal taking and possession	26	2,279 00	63	32	1,495 00	17
Barracuda—undersized	20	480 00	10	16	580 00	------
Halibut—undersized	3	100 00	------	4	30 00	------
Fish, young—illegal taking	4	250 00	------	5	140 00	------
Clams—taking and possession closed season; over bag limit; undersized	225	7,048 00	------	222	6,650 00	287
Abalones—taking and possession closed season; taking with diving apparatus; over bag limit; undersized	255	6,670 00	105	287	5,620 00	5
Crabs—taking and possession, closed season; females; undersized; transporting from District 1½	36	945 00	70	27	985 00	------
Lobsters—taking and possession closed season; over bag limit; undersized	39	1,050 00	190	54	2,090 00	------
Spot fin croaker—illegal sale; possession of	1	50 00	------	------	------------	------
Salt water ells—small	3	45 00	------	2	40 00	------
Fish—spear, gaff hooks, illegal	17	515 00	------	90	1,885 00	112½
Fishing—250 feet of fishway, 150 feet lower side dam, 150 feet upper side screens; too near ladder	8	150 00	------	24	520 00	25
Fishing—closed district	7	125 00	------	------	------------	------
Night fishing	18	535 00	------	4	200 00	------
Cockles—undersize	5	80 00	------	4	75 00	100
Pollution	7	825 00	------	18	900 00	------
Nets, traps, seines, lines, illegal possession of, use of	86	6,480 00	307	56	4,455 00	84
Sturgeon—possession of	5	350 00	------	2	40 00	------
Failure to keep commercial fishing data	3	210 00	------	------	------------	------
Reduction Act	------	------------	------	4	25 00	------
Perch—over limit	5	95 00	------	------	------------	------
Grunion—closed season	15	155 00	------	3	65 00	------
Shad—selling in closed season; over limit	1	50 00	------	6	30 00	------
Crawfish—undersize	------	------------	------	1	25 00	------
Totals	1,423	$43,330 50	1365½	1,566	$42,777 00	775½

GAME CASES

	July 1, 1928, to June 30, 1929			July 1, 1929, to June 30, 1930		
	Number of arrests	Fines and forfeitures imposed	Jail sentence (days)	Number of arrests	Fines and forfeitures imposed	Jail sentence (days)
Violations, Hunting License Act	299	$6,460 00	400	304	$7,710 00	112
Violations, Deer Tag License Act Deer—buy or sell; run with dogs; taking and possession, closed season; failure to retain horns and hide; over bag limit Deer—taking and possession does, fauns, spiked bucks; forked-born in District 1¾	260	$16,600 00	932	281	$15,450 00	1,946
Violations, Commercial Gun Club License Act	1	25 00	------	3	105 00	------
Rabbits—cottontail and brush; taking and possession, closed season	41	1,166 00	37	31	570 00	------
Squirrels, tree, taking and possession (no open season)	11	410 00	30	11	440 00	30
Ducks—buy or sell; taking and possession, closed season; over bag limit	78	3,875 00	55	48	2,115 00	240
Geese—taking and possession, closed season; over bag limit	7	315 00	30	8	200 00	------
Swans—taking and possession (no open season)	7	280 00	------	1	50 00	------
Mudhens—taking and possession, closed season	12	115 00	------	1	------------	10
Shorebirds—taking and possession (no open season)	39	990 00	------	62	1,345 00	5
Doves—taking and possession, closed season; over bag limit	44	1,440 00	180	78	2,390 00	31
Pigeons	12	310 00	------	12	650 00	------
Quail	108	5,125 00	130	55	2,400 00	15
Grouse	2	35 00	------	------	------------	------
Pheasants	14	625 00	310	18	1,550 00	180
Game farming, no license	------	------------	------	1	------------	------
Sagehens	1	25 00	------	------	------------	------
Non-game birds	120	3,750 00	60	92	2,525 00	------
Trespass	19	415 00	------	19	540 00	------
Bear, closed district	------	------------	------	1	------------	------
Bird nets and traps	5	150 00	100	3	150 00	------
Game refuge	11	275 00	------	9	250 00	------
Night hunting	71	1,100 00	109	50	1,435 00	------
Snipe, plover	1	75 00	------	------	------------	------
Shooting game from aeroplane, auto, power, or sail boat. Illegal use of sail boat	37	900 00	40	16	290 00	180
Trapping game birds	1	25 00	------	------	------------	------
Guns, illegal possession	20	600 00	------	14	415 00	6
Violation of trapping regulations	34	677 00	19	12	155 00	60
Sierra hen	1	------------	------	------	------------	------
Wood ducks	5	100 00	------	4	50 00	------
Sea gulls	2	30 00	------	------	------------	------
Possession, mountain sheep	1	300 00	------	------	------------	------
Refusal to exhibit game birds	1	300 00	------	------	------------	------
Totals	1,265	$46,493 00	2,432	1,134	$40,785 00	2,815

SEIZURES OF FISH AND GAME

	July 1, 1928 to June 30, 1929	July 1, 1929 to June 30, 1930	Total
Trout	937	1,848	2,785
Trout (pounds)	647	480	1,127
Beach bass	303	385	688
Sunfish, crappie, perch	1,132	912	2,044
Bonita	2,862	------------	2,862
Catfish (pounds)	845	319	1,164
Striped bass (pounds)	368	814	1,182
Striped bass	670	611	1,281
Salmon (pounds)	964	2,421	3,385
Salmon	354	110	464
Barracuda (pounds)	12,482	16,829	29,311
Spotfin croaker (pounds)	125	------------	125
Saltwater perch (pounds)	62	------------	62
Sardine (pounds)	------------	4,600	4,600
Halibut (pounds)	1,155	531	1,686
Bluefin tuna	2,668	------------	2,668
Herring (pounds)	------------	9,530	9,530
Cockels (pounds)	110	------------	110
Crabs	724	789	1,513
Carp (pounds)	------------	301	301
Clams	7,074	7,258	14,332
Abalone meat (pounds)	6,084	334	6,418
Abalones	988	2,468	3,456
Steelhead (pounds)	------------	80	80
Steelhead	------------	11	11
Lobsters	2,795	2,150	4,945
Lobsters (pounds)	3,633	1,341	4,974
Small fish (pounds)	------------	101	101
Sturgeon (pounds)	83	56	139
Sturgeon	5	------------	5
Shad	------------	55	55
Miscellaneous, fish	205	71	276
Nets, traps, set lines and dip nets	17	18	35
Spears	------------	14	14
Deer meat (pounds)	2,264	1,397	3,661
Deer	65	116	181
Deer hides	8	14	22
Squirrels	4	7	11
Rabbits, sierra hare, brush and cottontail	124	67	191
Ducks	1,660	1,385	3,045
Geese	119	95	214
Swans	6	3	9
Mudhens	24	5	29
Shorebirds	208	122	330
Doves	597	1,521	2,118
Pigeons	22	24	46
Quail	803	170	973
Quail, can-cans	------------	30	30
Sagehens	9	2	11
Pheasants	11	21	32
Non-game birds	309	379	688
Bird nets	10	3	13
Fur bearing animals—skins	211	14	225
Grouse	2	3	5
Wood duck	4	------------	4
Jack snipe	------------	53	53
Sea gulls	2	1	3
Bear	------------	1	1
Steel traps	------------	4	4
Gun	------------	1	1

FISH DISTRIBUTION BY COUNTIES, SEASON 1928

BEAR LAKE HATCHERY

County	Rainbow
San Bernardino	634,500
Riverside	18,000
Total	652,500

BLACKWOOD TANKS

County	Black spotted
Placer	200,000

BROOKDALE HATCHERY

County	Rainbow	Steelhead
San Mateo	22,000	92,000
Santa Cruz	116,000	25,000
Totals	138,000	117,000

BURNEY CREEK HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook
Lassen	14,000			1,000
Modoc	93,000	81,000	44,000	75,000
Shasta	95,000	38,000	47,000	49,000
Totals	202,000	119,000	91,000	125,000

CLEAR CREEK HATCHERY

County	Rainbow	Loch Leven	Eastern brook
Lassen	282,000	281,200	77,000
Plumas	265,000	220,000	40,000
Shasta			12,000
Sierra	10,000	7,000	16,500
Totals	557,000	508,200	145,500

DOMINGO SPRINGS HATCHERY

County	Rainbow
Plumas	8,000
Shasta	108,000
Lassen	40,000
Total	156,000

FALL CREEK HATCHERY

County	Rainbow
Siskiyou	371,000

FORT SEWARD HATCHERY

County	Rainbow	Steelhead	Cutthroat
Humboldt	80,000	582,350	100,000
Mendocino	50,000	366,000	----------
Trinity	20,000	5,000	----------
Totals	150,000	953,350	100,000

FEATHER RIVER HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	Black spotted
Butte	16,400	----------	----------	7,500	38,000
Plumas	85,200	48,000	2,000	98,500	204,000
Sierra	14,250	46,000	----------	92,000	94,000
Yuba	6,150	----------	----------	----------	18,000
Totals	122,000	94,000	2,000	198,000	354,000

FERN CREEK HATCHERY

County	Rainbow	Steelhead	Black spotted
Alpine	----------	34,000	118,000
Calaveras	----------	----------	80,000
Fresno	----------	15,000	----------
Madera	20,000	----------	----------
Mono	42,000	451,000	300,000
Totals	62,000	500,000	498,000

KAWEAH HATCHERY

County	Rainbow	Steelhead
Tulare	186,570	173,935

KERN RIVER HATCHERY

County	Rainbow	Loch Leven	Steel head	Eastern brook
Kern	92,000	94,000	95,000	37,000

KINGS RIVER HATCHERY

County	Rainbow
Fresno	67,000

MORMON CREEK HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	Black spotted	German brown
Calaveras	186,350	40,000	208,085		31,350	86,000
Tuolumne	114,400	288,000	84,800	88,000		
Totals	300,750	328,000	292,885	88,000	31,350	86,000

MT. SHASTA HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	Black spotted	German brown	Quinnat salmon
Alameda		10,000					
Amador	108,000	26,000		40,000		133,000	
Butte	197,484	20,000	10,000	30,000	40,000		
Colusa	14,000			6,000			
Del Norte	96,970			32,000			
El Dorado	82,000	125,000		15,000		150.000	
Fresno	76,000	238,000		165,000		147,000	
Glenn	28,000		10,000	2,000			
Humboldt	19,830						
Inyo						200,000	
Kern						91,000	
Lake	25,000	100,000					
Madera	30,000	64,000		50,000		10,000	
Mariposa						200,000	
Marin			45,000			100,000	
Mendocino		50,000				50,000	
Monterey		104,500	182,000				
Napa		160,000					
Nevada	144,000	604,800		21,000		16,000	
Placer	70,000	185,200		100,000		124,000	
Plumas	38,230	245,000		152,000	122,000		
San Benito		20,000					
San Francisco						1,000	
San Diego		100,000				300,000	
San Luis Obispo		116,000					
Santa Clara		10,000					
Santa Cruz	7,000		152,000		50,000		
Shasta	211,000	122,000		57,000	18,000	13,000	
Sierra				84,000			
Siskiyou	267,030	313,500		186,000	30,000	107,000	805,000
Sonoma		400,000				550,000	
Tehama	212,461	30,000		40,000			
Trinity	255,170		5,000	201,000	30,000		
Tulare		214,000		88,000		17,000	
Ventura		100,000					
Totals	1,882,175	3,358,000	404,000	1,269,000	290,000	2,209,000	805,000

MT. TALLAC HATCHERY

County	Rainbow	Steelhead	Black spotted
El Dorado		138,000	394,000
Nevada	195,000		
Totals	195,000	138,000	394,000

MT. WHITNEY HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	Black spotted	Golden
Alpine				94,000		
Amador			50,000			
El Dorado			170,000		100,000	
Fresno	10,000			10,000	33,000	15,000
Inyo	121,000	111,000	151,000	187,000	152,000	166,000
Nevada			54,000		110,000	
Madera	30,000				45,000	
Mono	94,000	100,000	22,000	314,000	60,000	143,000
Monterey			82,500			
Placer			162,000			
Riverside		15,000	22,000			
San Bernardino			40,000			
San Diego			188,000			
San Luis Obispo			220,000			
Santa Barbara	25,000	59,000	54,000			
Sierra			104,000			
Tuolumne						25,000
Ventura	20,000	15,000	135,000			
Totals	300,000	300,000	1,454,500	605,000	500,000	449,000

PRAIRIE CREEK HATCHERY

County	Steelhead	Silver salmon	Quinnat salmon
Humboldt	354,650	122,760	3,900
Santa Clara	210,000		
Totals	564,650	122,760	3,900

SAN GABRIEL HATCHERY

County	Rainbow
Los Angeles	466,970
Riverside	1,500
San Bernardino	21,000
Santa Barbara	3,000
San Diego	3,000
Total	495,470

SANTA ANA HATCHERY

County	Rainbow
San Bernardino	497,169

TAHOE HATCHERY

County	Loch Leven	Steelhead	Eastern brook	Black spotted
El Dorado	85,000	22,000	130,000	292,500
Placer	100,000	14,000	275,000	175,000
Nevada		40,000		145,000
Totals	185,000	76,000	405,000	612,500

TRANSPLANTATION

County	Miscel-laneous	Crappie	Blue gill sunfish	Catfish	Black bass	Striped bass
Inyo	525			1,400		
Lassen	650					
Los Angeles					565	
Placer					20	
San Diego					450	
San Mateo		50	20	60		
Santa Clara						50
Santa Cruz			30		30	
Shasta	24					
Solano	2,600					
Stanislaus				60,000		
Sutter		20			30	
Totals	3,799	70	50	61,460	1,095	50

FISH DISTRIBUTION BY COUNTIES, SEASON 1929

BEAR LAKE HATCHERY

County	Rainbow	Black spotted
San Bernardino	469,980	66,720

BIG CREEK HATCHERY

County	Steelhead
San Mateo	128,000
Santa Clara	136,000
Santa Cruz	351,000
Total	615,000

BROOKDALE HATCHERY

County	Rainbow	Steelhead	Silver salmon
San Mateo		36,000	
Santa Cruz	5,000	4,700	281,200
Totals	5,000	40,700	281,200

BURNEY CREEK HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	Black spotted
Modoc	320,000	140,000	149,000	154,000	85,000
Shasta	104,000	40,000	47,000	135,000	711,000
Trinity	92,000	----------	15,000	15,000	340.000
Totals	516,000	180,000	211,000	304,000	1,136,000

CLEAR CREEK HATCHERY

County	Rainbow	Loch Leven	Eastern brook
Lassen	361,000	----------	33,000
Plumas	184,092	413,495	77,000
Shasta	62,000	----------	----------
Tehama	----------	60,000	----------
Totals	607,092	473,495	110,000

COLD CREEK HATCHERY

County	Loch Leven	Steelhead	German brown	Atlantic salmon
Del Norte	----------	----------	----------	24,000
Lake	----------	68,000	----------	----------
Marin	----------	115,000	105,000	----------
Mendocino	134,000	529,000	136,500	12,000
Napa	20,000	20,000	----------	----------
Sonoma	----------	35,000	----------	----------
Totals	154,000	767,000	241,500	36,000

DOMINGO SPRINGS HATCHERY

County	Rainbow
Lassen	140,908
Plumas	514,000
Shasta	176,000
Tehama	50,000
Total	880,908

FALL CREEK HATCHERY

County	Rainbow	Steelhead	Quinnat salmon
Siskiyou	580,000	225,000	3,603,000

FEATHER RIVER HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook
Nevada	----------	----------	28,000	----------
Plumas	227,000	229,000	168,000	82,000
Sierra	29,000	30,000	115,000	35,000
Totals	256,000	259,000	311,000	117,000

FERN CREEK HATCHERY

County	Rainbow	Steelhead	Black spotted
Alpine	27,000	63,000	133,000
Inyo	----------	----------	50,000
Madera	10,000	55,000	----------
Mono	35,000	528,000	335,000
Totals	72,000	646,000	518,000

FORT SEWARD HATCHERY

County	Rainbow	Steelhead	Silver salmon
Humboldt	80,000	1,505,000	1,175,170
Trinity	30,730	35,000	----------
Totals	110,730	1,540,000	1,175,170

KAWEAH HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook
Kern	119,000	----------	104,000	62,000
Tulare	191,620	38,100	217,070	111,050
Ventura	----------	----------	20,000	----------
Totals	310,620	38,100	341,070	173,050

KINGS RIVER HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook
Fresno	171,000	385,000	90,000	55,000

MORMON CREEK HATCHERY

County	Rainbow	Loch Leven	Eastern brook
Calaveras	220,400	132,000	54,000
Tuolumne	290,700	108,200	75,050
Totals	511,100	240,200	129,050

MT. SHASTA HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	German brown	Quinnat salmon
Alameda		10,000				
Amador	98,000	143,000		5,000	170,000	
Butte	352,000	200,000	57,000	75,000	60,000	
Colusa	55,000					
Del Norte	95,000			49,000		
El Dorado	242,000	395,000		10,000	230,000	
Fresno		170,000				
Glenn	25,000			8,000		
Kern					38,000	
Lake	10,000					
Madera	81,000	39,000		152,000	5,000	
Mariposa	55,000			27,000		
Mendocino					450,000	
Monterey	260,000	140,000	186,000			
Nevada	314,000	636,000	310,000	96,000	230,000	
Placer	300,000	310,000	60,000	10,000	95,000	
Plumas	242,000	130,000	12,000	15,000		
San Benito	30,000		10,000			
San Diego					170,000	
San Francisco		12,000				
Shasta	282,000	175,000		91,000	45,000	
Sierra	30,000	40,000	5,000			
Siskiyou	735,000	506,000	190,000	143,000	424,000	898,000
Sonoma					250,000	
Tehama	209,000	159,000	55,000	16,000		
Trinity	87,000	30,000	10,000	15,000		
Tulare					25,000	
Tuolumne	100,000	100,000				
Yuba	22,000					
Totals	3,624,000	3,195,000	895,000	712,000	2,192,000	898,000

MT. TALLAC HATCHERY

County	Rainbow	Steelhead	Black spotted	Large lake
El Dorado	115,000	235,000	470,000	660,000
Nevada		165,000		
Totals	115,000	400,000	470,000	660,000

MT. WHITNEY HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	Black spotted	Golden
Alpine	10,000		48,000	87,000	47,000	25,000
Calaveras			40,000			125,000
Fresno	42,000		30,000			419,000
Inyo	309,500	195,000	386,500	190,000	135,000	
Kern			100,000			
Madera	28,000		63,000			10,000
Mono	145,000	85,000	435,000	253,000	145,000	321,000
San Diego			160,000			
Tulare						25,000
Ventura	70,000	10,000	150,000			
Totals	604,500	290,000	1,412,500	530,000	327,000	925,000

PRAIRIE CREEK HATCHERY

County	Quinnat salmon	Steelhead	Cutthroat	Silver salmon	Atlantic salmon
Humboldt	62,300	496,300	65,350	189,300	4,395

SANTA ANA HATCHERY

County	Rainbow	Black spotted
San Bernardino	507,000	157,025

SAN GABRIEL HATCHERY

County	Rainbow
Los Angeles	410,850
Riverside	55,400
Total	466,250

TAHOE HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	Golden	Black spotted
El Dorado	90,000	84,000	105,000	510,000	24,000	135,000
Nevada	20,000		80,000	25,000		6,000
Placer	100,000		80,000	38,000		245,000
Sierra	5,000		36,000			
Totals	215,000	84,000	301,000	573,000	24,000	386,000

WAWONA HATCHERY

County	Steelhead
Mariposa	271,800

YOSEMITE HATCHERY

County	Rainbow	Loch Leven	Steelhead	Eastern brook	German brown
Mariposa	208,200	110,000	297,500	89,000	48,000
Madera	5,000				
Tuolumne	38,700		120,000	29,000	
Totals	251,900	110,000	417,500	118,000	48,000

YUBA RIVER HATCHERY

County	Loch Leven	Steelhead	Eastern brook
Nevada	165,000	15,000	34,000
Sierra	14,376	176,171	24,188
Yuba	10,000		11,000
Totals	189,376	191,171	69,188

TRANSPLANTATION

County	Miscellaneous	Crappie	Blue gill sunfish	Catfish	Black bass	Striped bass
Contra Costa		300				
Imperial						2,400
Inyo		400	400	400		
Lassen		940	372		10	
Los Angeles	175			2,050		
Orange				1,500		
Riverside	1,515					
Santa Barbara	450			500		
San Bernardino	475			1,300		
San Diego		775		1,075		
San Francisco					24	
San Mateo					12	
Santa Clara	100					
Totals	2,715	2,415	772	6,825	46	2,400

STEINHART AQUARIUM

County	Grayling
Mariposa	30,000

SUMMARY OF FISH DISTRIBUTION, SEASON 1928-1929

Hatchery	Rainbow	Loch Leven	Steelhead	Eastern brook
Bear Lake	1,122,480			
Big Creek			615,000	
Brookdale	143,000		157,700	
Burney Creek	718,000	299,000	302,000	429,000
Clear Creek	1,164,092	981,695		255,500
Cold Creek		154,000	1,862,000	
Domingo Springs	1,036,908			
Fall Creek	951,000		225,000	
Feather River	378,000	353,000	313,000	315,000
Fern Creek	134,000		1,146,000	
Fort Seward	260,730		2,493,350	
Kaweah	497,190	38,100	515,005	173,050
Kings River	238,000	385,000	90,000	55,000
Mormon Creek	811,850	568,200	292,885	217,050
Mt. Shasta	5,506,175	6,553,000	1,295,000	1,981,000
Mt. Tallac	310,000		538,000	
Mt. Whitney	904,500	590,000	2,867,000	1,135,000
Prairie Creek			1,060,950	
Santa Ana	1,004,169			
San Gabriel	961,720			
Tahoe	215,000	269,000	377,000	978,000
Wawona	109,000		333,300	
Yosemite	440,700	276,000	743,500	203,200
Yuba River		189,376	191,171	69,188
Kern River	92,000	94,000	95,000	37,000
Blackwood Tanks				
Walker River			16,000	
Transplantation				
Steinhart Aquarium				
Totals	16,998,514	10,750,371	15,528,861	5,847,988

SUMMARY OF FISH DISTRIBUTION, SEASON 1928-1929—Continued

Hatchery	Black spotted	German brown	Cutthroat	Golden
Bear Lake				
Big Creek	66,720			
Brookdale				
Burney Creek	1,136,000			
Clear Creek				
Cold Creek		241,500		
Domingo Springs				
Fall Creek				
Feather River	354,000			
Fern Creek	1,016,000			
Fort Seward			100,000	
Kaweah				
Kings River				
Mormon Creek	31,350	86,000		
Mt. Shasta	290,000	4,401,000		
Mt. Tallac	864,000			
Mt. Whitney	827,000			1,374,000
Prairie Creek			65,350	
Santa Ana	157,025			
San Gabriel				
Tahoe	998,500			24,000
Wawona	32,000			
Yosemite	203,500	48,000		
Yuba River				
Kern River				
Blackwood Tanks	200,000			
Walker River	36,000			
Transplantation				
Steinhart Aquarium				
Totals	6,212,095	4,776,500	165,350	1,398,000

SUMMARY OF FISH DISTRIBUTION, SEASON 1928-1929—Continued

Hatchery	Large lake	Quinnat salmon	Silver salmon	Atlantic salmon	Striped bass
Bear Lake			281,200		
Big Creek					
Brookdale					
Burney Creek					
Clear Creek					
Cold Creek				36,000	
Domingo Springs					
Fall Creek		6,854,000			
Feather River					
Fern Creek					
Fort Seward			1,271,880		
Kaweah					
Kings River					
Mormon Creek					
Mt. Shasta		1,703,000			
Mt. Tallac	660,000				
Mt Whitney					
Prairie Creek		69,200	312,060	4,395	
Santa Ana					
San Gabriel					
Tahoe					
Wawona					
Yosemite					
Yuba River					
Kern River					
Blackwood Tanks					
Walker River					
Transplantation					2,400
Steinhart Aquarium					
Totals	660,000	8,626,200	1,865,140	40,395	2,400

SUMMARY OF FISH DISTRIBUTION, SEASON 1928-1929—Continued

Hatchery	Black bass	Crappies	Blue gill sunfish	Catfish	Miscellaneous spiney rayed	Grayling
Bear Lake						
Big Creek						
Brookdale						
Burney Creek						
Clear Creek						
Cold Creek						
Domingo Springs						
Fall Creek						
Feather River						
Fern Creek						
Fort Seward						
Kaweah						
Kings River						
Mormon Creek						
Mt. Shasta						
Mt. Tallac						
Mt. Whitney						
Prairie Creek						
Santa Ana						
San Gabriel						
Tahoe						
Wawona						
Yosemite						
Yuba						
Kern River						
Blackwood Tanks						
Walker River						
Transplantation	1,191	2,485	822	68,275	6,514	
Steinhart Aquarium						30,000
Totals	1,191	2,485	822	68,275	6,514	30,000

RECAPITULATION, SEASON 1928-1929

Trout	62,337,679
Salmon	10,531,735
Spiney rayed	79 297
Striped bass	2,400
Grayling	30,000

REPORT OF OPERATIONS OF LICENSED GAME BREEDERS

	Sold during 1928	On hand December 31, 1928	Sold during 1929	On hand December 31, 1929
Pheasants—				
Ringneck	4,627	2,805	2,973	3,932
Golden	162	568	148	535
Silver	47	229	124	174
Reeves	59	109	66	153
Lady Amherst	29	125	22	115
Mongolian	82	232	95	119
Versicolor	36	122	35	47
Other species	186	142	29	57
Quail—				
Valley	1,838	3 352	1,549	3,483
Mountain	920	792	138	291
Gambel	174	571	90	229
Bobwhite	9	156	19	124
Hungarian Point	13	247	20	73
Other species	6	142	4	40
Ducks—				
Mallards	1,637	2,117	943	739
Sprig	2	58		34
Widgeon	3	11		5
Wood duck	56	110	24	75
Teal	22	54	2	55
Other species	8	55	10	141
Doves—				
Mourning	52	208	77	353
Other species	207	199	35	166
Deer—				
All species	7	403	8	592

REPORT ON ACTIVITIES OF FUR FARMERS

Species	Sold during 1928	On hand December 31, 1928	Sold during 1929	On hand December 31, 1929
Fox—				
Silver	65	255	107	502
Red	2	6		4
Gray	2	2	1	2
Blue	6	4		37
Cross	3	3	8	6
Raccoons	26	28	15	89
Martin		7		
Mink	25	45	11	91
Muskrat	21	1,021	36	5,131
Otter		3		3
Ringtail cats	2	5	3	
Skunk	192	45	101	137

DEER KILL BY COUNTIES, SEASON 1928

County	Points								
	2	3	4	5	6	7	8	9	Total
Alameda	198	54	10					1	263
Alpine	20	23	16	6	1				66
Amador	28	31	17	2					78
Butte	80	71	48	10	2	1			212
Calaveras	77	65	39	8	2				191
Colusa	162	84	24	2					272
Contra Costa	5	1							6
Del Norte	18	10	17	2		1			48
El Dorado	176	183	146	27	11	4	1		548
Fresno	292	230	177	44	13	6	1		763
Glenn	280	198	100	13	1				592
Humboldt	336	290	133	14	4				777
Imperial	2			1	1				4
Inyo	89	76	54	13	4		1	2	239
Kern	129	82	64	15	5				295
Kings	1		1	1					3
Lake	695	267	67	7	1	1			1,038
Lassen	26	146	156	46	10	5	2	2	393
Los Angeles	256	70	34	8	1				369
Madera	126	84	69	15	3	1	1	1	300
Marin	362	68	11	3					444
Mariposa	50	47	28	7	2				134
Mendocino	791	477	173	24	2		1		1,468
Merced	45	16	5	1				1	68
Modoc		269	325	88	26	11	5	5	729
Mono	12	11	22	8	2				55
Monterey	536	217	58	15	2	1	1		830
Napa	327	179	55	4	4				569
Nevada	51	44	34	7	3	1			140
Orange	36	22	10	1					69
Placer	125	126	72	12	4	4	2	1	346
Plumas	177	192	178	27	7	3	1	1	586
Riverside	120	76	40	12	1				249
Sacramento	1		1						2
San Benito	210	90	19	1					320
San Bernardino	57	34	19	10	1	1			122
San Diego	120	76	31	5					232
San Francisco									
San Joaquin	10	4							14
San Luis Obispo	290	112	36	10	2				450
San Mateo	83	4	1	1					89
Santa Barbara	526	204	95	21	4	1			851
Santa Clara	371	134	28	2	1				536
Santa Cruz	81	7	4						92
Shasta	175	230	162	21	10	1	1	3	603
Sierra	26	30	35	6	3	1		1	102
Siskiyou	450	522	520	108	35	11	3	5	1,654
Solano	30	15	6	1					52
Sonoma	506	194	46	7					753
Stanislaus	69	28	14	3	1				115
Sutter	2	1							3
Tehama	280	329	197	32	4	4			846
Trinity	295	310	169	20	3	2	1		800
Tulare	484	250	170	28	4	1	1	1	939
Tuolumne	74	88	43	7	1				213
Ventura	226	99	32	3	2				362
Yolo	97	46	23	2	1				169
Yuba	22	21	8				1		52
Totals	10,113	6,537	3,842	731	184	61	23	24	21,515

DEER KILL BY COUNTIES, SEASON 1929

County	Points								
	2	3	4	5	6	7	8	9	Total
Alameda	205	64	5		1				275
Alpine	24	32	27	4	1	1			89
Amador	32	27	22	3	1	2			87
Butte	82	70	63	15	2	1		1	234
Calaveras	61	58	39	14	2			1	175
Colusa	184	85	26	2					297
Contra Costa	11	2	1						14
Del Norte	27	13	13	2					55
El Dorado	215	202	142	26	9	1	1	1	597
Fresno	283	232	188	50	5	3	1	2	764
Glenn	306	210	68	1	1				586
Humboldt	284	249	146	6	2	2			689
Imperial	2	1	1						4
Inyo	96	81	60	14	1	1			253
Kern	135	103	41	14	3	1			297
Kings	2	1							3
Lake	583	194	57	6	1				841
Lassen	35	166	223	52	20	10	1	4	511
Los Angeles	470	150	60	11					691
Madera	122	91	79	13	5	2	1		313
Marin	337	48	7	1	1				394
Mariposa	53	52	29	7		3			144
Mendocino	728	422	180	18	6	1			1,355
Merced	29	15	4						48
Modoc		300	386	95	21	21	7	5	835
Mono	32	20	16	6	1			1	76
Monterey	502	173	46	12				1	734
Napa	332	149	37	5					523
Nevada	62	47	51	5	3	1			169
Orange	50	22	7	2					81
Placer	112	124	77	16	5	1			335
P umas	233	194	210	42	8	3	2	3	695
Riverside	216	93	69	23	3				404
Sacramento									
San Benito	180	67	19	2	1				269
San Bernardino	66	29	17	7	1				120
San Diego	114	66	37	16					233
San Francisco									
San Joaquin	18	4							22
San Luis Obispo	255	140	43	12	2	2		1	455
San Mateo	78	22	2						102
Santa Barbara	445	164	90	13	3	1	1		717
Santa Clara	403	131	37	5	1				577
Santa Cruz	84	16	2						102
Shasta	190	267	191	35	9	4	5	1	702
Sierra	44	42	35	8	2	1			132
Siskiyou	218	366	495	86	22	12	5	7	1,211
Solano	31	20	3						54
Sonoma	469	216	47						732
Stanislaus	77	33	9						119
Sutter	1	1							2
Tehama	284	262	171	29	9	2	1		758
Trinity	234	277	201	32	3	3	1		751
Tulare	361	257	154	32	1	2			807
Tuolumne	70	74	53	11	3	1			212
Ventura	233	75	30	8					346
Yolo	100	49	23	4					176
Yuba	23	14	16	2					55
Totals	9,823	6,282	4,055	767	159	82	26	28	21,222

STATEMENT OF MOUNTAIN LION BOUNTIES PAID BY DIVISION OF FISH AND GAME

County	1907-1925	1926	1927	1928	1929	Total
Alameda	2					2
Alpine	3					3
Amador	12	1	1	1	3	18
Butte	35	1	1	1	2	40
Calaveras	20	2	4	9	3	38
Colusa	25	5	2	2	4	38
Contra Costa						
Del Norte	121	4	9	5	8	147
El Dorado	85	13	17	5	7	127
Fresno	48	4	12	7		71
Glenn	65	2	1	10	2	80
Humboldt	647	13	15	10	21	706
Imperial	2					2
Inyo	16			1		17
Kern	228	20	14	20	3	285
Kings	1					1
Lake	198	22	9	27	28	284
Lassen	9					9
Los Angeles	83	3	3	11	22	122
Madera	45	1	1	2	1	50
Marin						
Mariposa	99	13	3	7	4	126
Mendocino	323	20	14	32	13	402
Merced	4				1	5
Modoc	5					5
Mono	14	1		2		17
Monterey	210	26	23	37	34	330
Napa	3					3
Nevada	8			1		9
Orange	9					9
Placer	64	6	3	1	6	80
Plumas	10					10
Riverside	50	3		4	2	59
Sacramento	1					1
San Benito	45	3	1	1	1	51
San Bernardino	52	5	5	7	4	73
San Diego	58	3	10	7	34	112
San Francisco						
San Joaquin	2					2
San Luis Obispo	133	5	8	7	4	157
San Mateo	1					1
Santa Barbara	174	11	14	13	17	229
Santa Clara	44	3		3	2	52
Santa Cruz	4					4
Shasta	363	11	13	15	16	418
Sierra	6				1	7
Siskiyou	280	3	16	8	8	315
Solano						
Sonoma	25		1	1		27
Stanislaus	13			3	1	17
Sutter	2					2
Tehama	228	5	6	9	11	259
Trinity	355	11	4	33	28	431
Tulare	226	4	12	16	9	267
Tuolumne	123	11	2	7	2	145
Ventura	91	14	17	2	6	130
Yolo						
Yuba	10			5	1	16
Totals	4,680	249	241	332	309	5,811

CALIFORNIA FISHERY PRODUCTS

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1928

(Compiled by Division of Fish and Game, Bureau of Commercial Fisheries)

Canned

Species of fish	Size of cans	Northern California district, cases	Monterey district, cases	San Pedro district, cases	San Diego district, cases	Tota cases
Abalone	1-lb. tall		255			255
	½-lb.		80			80
Albacore	1-lb.			8,544	7	8,551
	½-lb			84,977	637	85,614
	¼-lb.			1,736	14	1,750
	¼lb. (96 to case)			3,836		3,836
Bonito	1-lb.			1,417	131	1,548
	½-lb.			12,410	3,258	15,668
	¼-lb.				1,654	1,654
	¼-lb. (100 to case)			30		30
Fish cakes	1-lb.			2,101		2,101
	½-lb.			10,984		10,984
Mackerel	1-lb. tall		1,030	357,136	25,110	383,276
	½-lb.			4,717	208	4,925
	¼-lb.				270	270
Salmon	1-lb. flat	461				461
	½-lb. flat	4,124				4,124
Sardines	10-lb.		263			263
	1-lb. oval		1,511,535	945,676	39,755	2,496,966
	1-lb. tall		4,569	9,652		14,221
	½-lb. oval		43,754		671	44,425
	½-lb. square		159		725	884
	¼-lb. square		2,232		30,540	32,772
	6-oz. tall (100 to case)		80,252	143,724	1,823	225,799
Shad	1-lb. tall	7,475				7,475
Shad roe	½-lb. oval	2,883				2,883
Squid	1-lb. tall		2,056			2,056
Tonno	4-lb. (12 to case)			903		903
	1-lb.			45		45
	½-lb.			14,592	221	14,813
	½-lb. (50 to case)			3,502		3,502
	¼-lb.			426		426
	¼-lb. (100 to case)			86,570	11,562	98,132
Tuna, bluefin	1-lb.			9,929	1,669	11,598
	½-lb.			55,411	37,095	92,506
	¼-lb.			18,535	7,584	26,119
	¼-lb. (96 to case)			726		726
	⅛-lb. (96 to case)			1,393		1,393
Tuna, flakes	4-lb. (12 to case)			49		49
	1-lb.			1,726	1,086	2,812
	½-lb.			4,728	7,282	12,010
	¼-lb.				788	788
	¼-lb. (100 to case)			405		405
	¼-lb. (48 to case)			669		669
Tuna, striped	1-lb.			6,664	11,740	18,404
	½-lb.			45,924	90,160	136,084
	¼-lb.			11,473	28,530	40,003
Tuna, unclassified	1-lb.			2,147	4,455	6,602
	½-lb.			42,595	49,195	91,790
	¼-lb.			2,209	7,905	10,114
Tuna, yellowfin	4-lb.			1,081		1,081
	1-lb.			28,682	24,015	52,697
	½-lb.			228,395	162,758	391,153
	¼-lb.			18,023	39,442	57,465
	¼-lb. (96 to case			30		30
	⅛-lb. (96 to case)			651		651
Yellowtail	1-lb.			516	301	817
	½-lb.			386	526	912
	¼-lb.				3,928	3,928
Totals		14,943	1,646,185	2,175,325	595,045	4,431,498

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1928 —Continued

Salted, Smoked and Dried

Species of fish	Size or quantity	Northern California district	Monterey district	San Pedro district	San Diego district	Total
Anchovies	2½-lb. cans (12 to case)		32			32
Anchovies, salted	10-lb. kits	95				95
	25-lb. kits		13			13
	280-lb. bbls.		29			29
Bismarck herrings	10-lb. pails	460				460
Herrings, smoked	Pounds	28,110				28,110
Mackerel, salted	10-lb. kits	3,020				3,020
Mackerel, smoked	Pounds			23,192		23,192
Mixed fish, dried	Pounds	114,459				114,459
Mixed fish salted	Pounds				258,143	258,143
Rollmops	10-lb. kits	675				675
Sablefish, smoked	Pounds	110,193				110,193
Salacchini	10-lb. cases		325			325
	50-lb. cases		4,155			4,155
	100-lb. cases		50			50
Salmon, mild cured	Tierces	1,874				1,874
Salmon, salted	Pounds	4,380				4.380
Salmon, smoked	Pounds	46,125				46,125
Sardines, salted	25-lb. kits		1,156			1,156
	50-lb. bbls.		78			78
	100-lb. bbls.		43			43
	280-lb. bbls.		201			201
Sardines, smoked	Pounds	20,202				20,202
Sardines, sirloins	8-oz. jars (24 to case)		98			98
Shad, mild cured	Tierces	196				196
Shad, smoked	Pounds	5,000				5,000
Shrimps, dried	Pounds	85,918				85,918
Squid, dried	Pounds		154,600			154.600

Miscellaneous Data

Species of fish	Size or quantity	Northern California district	Monterey district	San Pedro district	San Diego district	Total
Fish flour	Tons		525			525
Fish meal	Tons	220	12,355	12,923	2,367	27,865
Fish oil	Gallons	11,847	2,444,869	1,268,518	24,068	3,749,302
Estimated value of pack		$708,415	$7,712,747	$12,263,151	$3,894,543	$24,578,856
Number of employees		432	1,898	3,090	1,289	6,709
Value of packing plants		$1,075,420	$2,369,400	$4,865,891	$1,117,175	$9,427,886
Number of plants		27	15	18	8	68

NOTE.—Sardines packed and fish meal and oil produced at Pittsburg included with Monterey.

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE YEAR 1928

(Compiled by the Division of Fish and Game, Department of Commercial Fisheries)

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey
Albacore									180
Anchovies							125,515	106	175,380
Barracuda								21	963
Bonito								596	110
Carp		74,894		12,042	37,028	32,463	856		
Catfish		73,917		7,099	225,756	151,620			
Cultus Cod	44,466	63,866	365				524,352	94,188	120,773
Eels							5		
Flounders	12,220	46,080		25	65		298,508	39,855	1,258
Grayfish		260					400,478	24,540	56,700
Hake							76,047	32,521	80
Halibut	320,190	30,633	64				24,859	3,752	17,915
Hardhead		11,090			50,609				
Herring	61,442		441,473			22,875	590,230	125	440
Kingfish							26,785	30,517	60,977
Mackerel							2,262	2,480	1,294,434
Mackerel, Horse									28,944
Mullet									
Perch	38,314	3,151	57,158			3	29,835	5,530	18,532
Pike				157	1,936	1,687			
Pompano								6	2,197
Rock Bass									
Rockfish	82,920	24,344	285				997,973	686,985	1,599,359
Sablefish	384,825	360					342,029	146,543	36,525
Salmon	1,211,600	1,562,715		116,485	180,679	256,613	815,815	75,246	259,408
Sandabs		34,890					843,206	202,389	11,688
Sardines	87						26,965,736	1,638	221,566,640
Sculpin								1,729	899
Sea Bass—Black									
Sea Bass—White			18,080				17,835	22,404	3,490
Shad				1,634	489	9,746	82,870		
Shad—Buck				116,053	40,637	611,614			

Shad—Roe				217,286	61,932	946,617			
Sheepshead									
Skates		2,340					315,517	42,012	70,538
Skipjack								1,186	8
Smelt	62,835	326	44,153			577	68,976	119,071	52,431
Sole	3,945	218,096					7,958,700	1,511,378	299,566
Splittail					10,268	472			
Striped Bass			90	43,712	126,333	298,551	15,427		
Sting ray									
Suckers					1,018	11			
Swordfish									
Tomcod							11,798	125	
Tuna—Bluefin									
Tuna—Yellowfin									
Turbot			2,659				6,575		
Whitebait	100,236	16,480	233				14,388		3,849
Whitefish									
Yellowtail									
Miscellaneous	3,677	3,079		60	84	62	29,808	9,281	11,261
Total fish	2,326,757	2,166,521	564,560	514,553	736,834	2,332,911	40,586,385	3,054,224	225,694,545
Crustaceans:									
Crabs	[1]84,480	[7]1,128				[8]312	[3]3,014,448	[5]457,728	[6]15,888
Shrimps			1,932,147				348,724		
Spiny Lobsters									
Mollusks:									
Abalones									2,049,875
Clams—Cockle		257	22,394						
Clams—Mixed	8,925	45	34,022						1,017
Clams—Pismo								45	2,110
Clams—Softshell		569	86,939			43,947	16,967		120
Cuttlefish							2,553	725	6,404
Mussels						80	160		1,370
Oysters—Eastern		[2]427,978					[4]298,320		
Oysters—Native							26,850		
Squid									1,351,992
Miscellaneous:									
Terrapins					168				
Turtles									
Totals	2,420,162	2,168,520	3,068,040	514,553	737,002	2,377,250	44,294,407	3,512,722	229,123,321

All amounts shown in pounds unless otherwise specified. Albacore and skipjack cleaned.

[1] 3,520 dozen. [2] 1,945,369 shell oysters.
[3] 125,602 dozen. [4] 1,356,000 shell oysters.
[5] 19,072 dozen. [6] 662 dozen.
[7] 47 dozen. [8] 13 dozen.

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE YEAR 1928—Continued

Species of fish	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego, Imperial	Total	Fish from south of the International Boundary brought into San Pedro	Fish from south of the International Boundary brought into San Diego	Total from south of the International Boundary brought into California
Albacore	190	253,876	4,922	24,153	283,321			
Anchovies		51,374	4,365	730	357,470			
Barracuda	14,638	3,465,550	53,551	850,491	4,385,214	1,713,038	354,204	2,067,242
Bonito	537	630,237	5,870	680,613	1,317,963	711,645	58,725	770,370
Carp					157,283			
Catfish					458,392			
Cultus Cod	280	727	39		849,056			
Eels		222			227			
Flounders		1,463	16		399,490			
Grayfish		127,957	422	13,459	623,816			
Hake					108,648			
Halibut	248,353	478,929	49,402	133,938	1,308,035	1,178	254,184	255,362
Hardhead					61,699			
Herring	570			22,527	1,139,682			
Kingfish		319,062	299	4,118	441,758			
Mackerel	13,742	29,872,677	1,357,654	2,708,049	35,251,298		11,196	11,196
Mackerel, Horse		509,332	170		538,446	1,906		1,906
Mullet		3,618	1,877	23,744	29,239	6,459	47,041	53,500
Perch	3,193	74,145	15	5,768	235,644	312	978	1,290
Pike					3,780			
Pompano		860		232	3,295	1,286	25,501	26,787
Rock Bass	8,798	275,595	133,494	157,736	575,623	7,489	42,837	50,326
Rockfish	102,846	1,655,747	41,476	1,223,036	6,414,971		4,938	4,938
Sablefish	90	6,568	15		916,955			
Salmon	5				4,478,566			
Sandabs		16,193	8		1,108,374			
Sardines	312	164,616,935	1,757	7,116,560	420,269,665			
Sculpin	93	59,915	1,087	35,988	99,711			
Sea Bass—Black	829	32,473	32,794	138,766	204,862	11,157	165 686	176,843
Sea Bass—White	79,779	478,748	13,574	171,493	805,403	130,321	345,014	475,335
Shad					94,739			
Shad—Buck					768,304			

Shad—Roe					1,225,835			
Sheepshead	6,770	328,045	2,825	34,849	372,489	188		188
Skates		25,396	389	2,734	458,926			
Skipjack	112	1,286,113		2,975,313	4,262,732	5,216,081	6,335,891	11,551,972
Smelt	56,386	399,192	87,914	23,637	915,498	1,167	54	1,221
Sole	218,941	58,851	2,259	8,683	10,280,419			
Splittail					10,740			
Striped Bass					484,113			
Sting ray				3,296	3,296			
Suckers					1,029			
Swordfish		103,318	487	322,196	426,001			
Tomcod					11,923			
Tuna—Bluefin		11,592,412	77	2,108,381	13,700,870			
Tuna—Yellowfin		77,353	49	5,264	82,666	15,397,232	16,771,348	32,168,580
Turbot					9,234			
Whitebait					135,186			
Whitefish	70	103,224	426	91,788	195,508	4,530	22,154	26,684
Yellowtail	71	287,006	5,151	1,004,809	1,297,037	521,370	865,107	1,386,477
Miscellaneous	2,367	120,247	1,809		181,735	5,162	9,496	14,658
Total fish	758,972	217,313,360	1,804,193	19,892,351	517,746,166	23,730,521	25,314,354	49,044,875
Crustaceans:								
Crabs		[9]270			[10]3,574,254			
Shrimps					2,280,871			
Spiny Lobsters	54,923	151,739	17,313	131,825	355,800	350	720,464	720,814
Mollusks:								
Abalones	16,368				2,066,243			
Clams—Cockle					22,651			
Clams—Mixed		653			44,662			
Clams—Pismo	123,050				125,205			
Clams—Softshell					148,542			
Cuttlefish		46	4		9,732			
Mussels					1,610			
Oysters—Eastern					[11]726,298			
Oysters—Native					26,850			
Squid					1,351,992			
Miscellaneous:								
Terrapins					168			
Turtles							5,594	5,594
Totals	953,313	217,466,068	1,821,510	20,024,176	528,481,044	23,730,871	26,040,412	49,771,283

[9] 11 dozen.
[10] 148,927 dozen.
[11] 3,301,369 shell oysters

CANNERY, FISH FLOUR, MEAL AND OIL PRODUCTION

Season June 1, 1928, to May 31, 1929

District	Tons fish received	Tons fish used for canning	Tons fish used for meal and flour	Tons offal
Monterey	131,859	81,773	49,635	27,267
San Pedro	119,180	65,702	53,478	21,901
San Diego	1,394	1,138	256	379
Totals	252,433	148.613	103,369	49,547
Deduct fish used for other purposes	15,728			
Fish used by canning plants	236,705			

District	Cases 1-lb. ovals packed	Cases other size cans packed	Other size cans equivalent to cases 1-lb. ovals	Cases per ton
Monterey	1,520,192	133,594	115.664	13.8
San Pedro	1,140,488	166,039	173,540	11.3
San Diego	12,383	13,411	10,368	16.3
Totals	2,673,063	313,044	299,572	

District	Fish flour, tons	Meal, tons	Ratio per ton of meal	Oil, gallons	Gallons oil per ton of fish and offal	Tons fish used for other purposes
Monterey	553	13,782	5.3	2,939 579	38.2	[1]12,764
San Pedro		14,802	5.1	2,178,815	28.9	[2]2,964
San Diego		140	4.1	6,857	11.7	
Totals	553	28,724		5,125,251		15,728

[1] 9,093 tons used for fish flour, 3,070 tons for edible oil and 601 tons for salting.
[2] 2,964 tons used for edible oil.

COMPARATIVE STATEMENT OF SARDINE CANNERY PRODUCTION, SEASONS 1927-28 AND 1928-29

Monterey

	Season 1927-28	Season 1928-29	Increase	Percentage increase
Tons fish received	109,744	131,859	22,115	20.1
Tons fish used for canning	76,322	81,773	5,451	7.1
Tons fish used for meal	33,202	49,635	16,433	49.4
Tons offal	25,437	27,267	1,830	7.7
Cases 1-lb. ovals packed	1,474,162	1,520.192	46,030	3.1
Cases other sizes packed	68,111	133,594	64,483	95.9
Other sizes equivalent to cases of 1-lb. ovals	54,985	115,664	60,679	110.3
Meal, tons	·10,538	13,782	3,244	30.7
Oil, gallons	1,859,982	2,938,579	1,078,597	57.9
Tons fish used for other purposes	6,736	12,764	6,028	8.9

COMPARATIVE STATEMENT OF SARDINE CANNERY PRODUCTION, SEASONS 1927-28 AND 1928-29

San Pedro

	Season 1927-28	Season 1928-29	Increase	Percentage increase
Tons of fish received	67,459	119,180	51,721	76.6
Tons of fish used for canning	51,061	65,702	14,641	28.6
Tons of fish used for meal	16,398	53,478	37,080	226.1
Tons of offal	17,021	21,901	4,880	28.6
Cases 1-lb. ovals packed	878,175	1,140,488	262,313	29.8
Cases other sizes packed	145,143	166,039	20,896	14.3
Other sizes equivalent to cases of 1-lb. ovals	145,143	173,540	28,397	19.6
Meal, tons	7,128	14,802	7,674	107.6
Oil, gallons	711,579	2,178,815	1,467,236	200.1
Tons of fish used for other purposes	226	2,964	2,738	1,211.5

SARDINE CATCH IN TONS BY MONTHS DURING SEASON 1928-29

	Monterey and Northern California	San Pedro	San Diego
June, 1928			48
July			
August	22,575		
September	26,434		
October	19,646	3,634	
November	4,931	15,113	
December	6,866	16,418	
January, 1929	17,240	23,096	257
February	21,025	24,194	439
March	13,142	30,627	507
April		1,061	59
May		5,037	84
Totals	131,859	119,180	1,39

CASE PACK OF 1-Lb. OVALS BY MONTHS, SEASON 1928-29

	Monterey and Northern California	San Pedro	San Diego
August	259,876		
September	300,264		
October	243,749	22,190	
November	55,406	118,630	
December	91,416	209,619	
January	219,872	243,934	1,198
February	219,225	206,274	3,720
March	130,384	273,497	7,084
April		9,547	
May		56,797	381
Totals	1,520,192	1,140,488	12,383

MEAL PRODUCTION IN TONS BY MONTHS, SEASON 1928-29

	Monterey and Northern California	San Pedro	San Diego
August	2,266		
September	2,796		
October	2,002	453	
November	508	2,014	
December	661	1,753	
January	1,675	2,846	14
February	2,339	3,086	35
March	1,535	4,084	62
April		117	11
May		449	18
Totals	13,782	14,802	140

OIL PRODUCTION IN GALLONS BY MONTHS, SEASON 1928-29

	Monterey and Northern California	San Pedro	San Diego
August	459,090		
September	626,313		
October	457,875	90,417	
November	97,610	354,677	
December	139,912	278,773	
January	395,095	418,292	750
February	485,639	431,608	1,490
March	277,045	582,610	4,617
April		19,091	
May		3,347	
Totals	2,938,579	2,178,815	6,857

PLANTS OPERATED, SEASON 1928-29

F. E. Booth Company	Pittsburg
Bayside Fish Flour Company	Monterey
F. E. Booth Company	Monterey
California Packing Corporation	Monterey
Carmel Canning Company	Monterey
Del Mar Canning Company	Monterey
E. B. Gross Canning Company	Monterey
K. Hovden Company	Monterey
Monterey Canning Company	Monterey
San Carlos Canning Company	Monterey
San Xavier Fish Packing Company	Monterey
Sea Pride Canning Company	Monterey
Vegetable Oil Products Company, Inc.	Monterey
California Packing Corporation	Terminal Island
Coast Fishing Company	Wilmington
Franco-Italian Packing Company	Terminal Island
French Sardine Company, Inc.	Terminal Island
General Fisheries Corporation	San Pedro
Globe Grain and Milling Company	Ostend
Italian Food Products Company, Inc.	Long Beach
L. A. Sea Food Packing Company, Inc.	Terminal Island
Linde Packing Company	Wilmington
Southern California Fish Corporation	Terminal Island
Toyo Fisheries Company, Inc.	Wilmington
Van Camp Sea Food Company, Inc.	Terminal Island
California Packing Corporation	San Diego
K. Hovden Company	Point Loma
San Diego Packing Company	Point Loma
Westgate Sea Products Company	San Diego
Wedum Packing Company*	Wilmington

*Sold to Linde Company, January 1, 1929.

The following table shows case pack, meal and oil production for calendar years 1916 to 1928:

1-Lb. OVALS, CASES

Year	Monterey and Northern California	San Pedro district	San Diego district	Total
1916	97,100	2,512	7,133	106,745
1917	331,065	43,221	34,380	408,666
1918	593,315	136,632	17,790	747,737
1919	798,566	113,909	33,594	946,069
1920	687,777	213,714	50,302	951,793
1921	287,954	77,048	1,189	366,191
1922	353,188	340,860	3,595	697,643
1923	580,464	488,885	19,215	1,088,564
1924	631,286	693,133	12,135	1,336,554
1925	737,743	920,191	29,846	1,687,780
1926	1,158,133	861,088	63,410	2,082,631
1927	1,341,872	1,046,453	14,947	2,403,272
1928	1,511,535	945,676	39,755	2,496,966

Fish Meal, Tons

Year	Monterey and Northern California	San Pedro district	San Diego district	Total
1916	249	261	25	535
1917	875	2,606	----------	3,481
1918	2,874	4,737	1,123	8,734
1919	3,812	5,667	1,674	11,153
1920	3,969	3,328	1,559	8,856
1921	2,115	3,566	636	6,317
1922	2,695	5,373	959	9,027
1923	3,806	4,216	1,216	9,238
1924	6,601	7,726	1,001	15,328
1925	7,105	13,023	2,808	22,936
1926	7,807	7,066	1,394	15,767
1927	9,347	9,746	2,018	21,111
1928	12,575	12,923	2,367	27,865

Includes all meal produced.

Fish Oil, Gallons

Year	Monterey and Northern California	San Pedro district	San Diego district	Total
1916	25,563		500	26,063
1917	92,393	83,900		176,293
1918	261,466	67,858	17,400	346,724
1919	341,173	146,298	26,791	514,262
1920	419,474	152,937	39,174	611,585
1921	226,826	93,305	16,607	336,738
1922	295,858	244,310	6,882	547,050
1923	576,553	346,883	28,452	951,888
1924	1,240,296	1,059,001	51,425	2,350,722
1925	1,246,561	1,715,663	187,847	3,150,041
1926	1,418,512	651,006	54,410	2,123,928
1927	1,759,480	763,905	95,105	2,618,490
1928	2,456,716	1,268,518	24,068	3,749,302

Includes all fish oil produced.

CASE PACK, MEAL AND OIL PRODUCTION

For Sardine Packing Seasons, June 1 to May 31

1-Lb. Ovals, Cases

Season	Monterey and Northern California	San Pedro district	San Diego district	Total
1925-1926	940,906	968,495	66,074	1,975,475
1926-1927	1,202,516	986,858		2,189,374
1927-1928	1,474,162	878,175	39,380	2,391,717
1928-1929	1,520,192	1,140,488	12,383	2,673,063

Fish Meal, Tons

Season	Monterey and Northern California	San Pedro district	San Diego district	Total
1925-1926	6,413	5,962	467	12,842
1926-1927	6,675	5,962		12,637
1927-1928	10,538	7,128	184	17,850
1928-1929	13,782	14,802	140	28,724

Fish Oil, Gallons

Season	Monterey and Northern California	San Pedro district	San Diego district	Total
1925-1926	1,113,612	658,817	43,995	1,816,424
1926-1927	1,562,351	682,796		2,245,147
1927-1928	1,859,982	711,579	10,253	2,581,814
1928-1929	2,939,579	2,178,815	6,857	5,125,251

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE YEAR 1929

(Compiled by Division of Fish and Game, Bureau of Commercial Fisheries)

Species of fish	Del Norte, Humboldt	Mendocino, Sonoma, Lake	Marin	Solano, Yolo	Sacramento, San Joaquin	Alameda, Contra Costa	San Francisco, San Mateo	Santa Cruz	Monterey
Albacore									
Anchovies							239,575		81,975
Barracuda								28	
Bonito								827	83
Carp				11,063	34,173	25,624	13,786		
Catfish		45,240		6,148	293,417	161,354			
Cultus Cod	140,978	233,804	623				572,925	79,677	126,601
Eels							10		
Flounders	9,041	38,502			246	588	474,420	52,114	1,186
Grayfish						104	365,427	10,413	123,786
Hake		130					131,323	13,875	341
Halibut	651,040	44,932	312				50.502	6,348	22,595
Hardhead					55,410				
Herring	30,693	681	374,172			16,250	530,579	375	
Kingfish		30					44,902	45,248	67,033
Mackerel							32,246	1,640	1,020,150
Mackerel—Horse									38,778
Mullet									
Perch	41,555	3,237	70,378			61	35,883	16,903	39,080
Pike				271	933	2,055			
Pompano							250	31	221
Rock Bass									
Rockfish	139,689	114,464	55			258	1,073,846	420,501	1,220,548
Sablefish	444,058	4,575					499,424	436,894	36,019
Salmon	1,520,624	1,229,936		115,910	155,319	250,081	658,718	339,049	715,047
Sandabs	225	21,910					952,348	57,246	4,761
Sardines			75				41,091,782	79,776	323,301,506
Sculpin	9	233						558	396
Sea Bass—Black									
Sea Bass—White		44	53,267				14,017	35,356	5,997
Shad				2,884	2,163	4,737	29,230		
Shad—Buck				78,914	48,673	453,242	50,448		
Shad—Roe				144,015	84,504	660,144	43,976		

Sheepshead									
Skates		390					317,920	4,500	78,787
Skipjack									
Smelt	94,014		31,239			908	92,064	105,393	82,601
Sole	24,208	162,441					10,672,792	491,799	134,566
Splittail					8,414	324			
Striped Bass			1,163	45,335	172,306	287,052	22,410		
Suckers				4	800	38			
Swordfish									
Tomcod							15,822	62	
Tuna—Bluefin									
Tuna—Yellowfin									
Turbot			1,135				188		
Whitebait	139,608	29,843	593				64,946	30	7,899
Whitefish									
Yellowtail									
Miscellaneous	16,400	5,054		110	333	470	26,213	9,415	195,705
Total fish	3,252,142	1,935,446	533,012	404,654	856,691	1,863,290	58,117,972	2,208,058	327,305,661
Crustaceans:									
Crabs	[1]63,696		[2]2,328			[4]168	[5]1,689,288	[7]37,224	[8]72
Shrimps			1,548,035				1,506,713		
Spiny Lobsters									
Mollusks:									
Abalones		8,751							3,412,460
Clams—Cockle		55	48,286						
Clams—Mixed	10,724		2,689						
Clams—Pismo								238	9,255
Clams—Softshell			66,722			24,423	10,305		10
Cuttlefish	25	4,008					14,112	2,787	65,761
Mussels							828		200
Oysters—Eastern			[3]169,419				[6]267,826		
Oysters—Native	720		54,084				3,680		3,478
Squid							445	9,389	4,563,166
Miscellaneous:									
Turtles									
Totals	3,327,307	1,948,260	2,424,575	404,654	856,691	1,887,881	61,611,169	2,257,696	335,360,063

All amounts shown in pounds unless otherwise specified. Skipjack and albacore cleaned.

[1] 2,654 dozen.
[2] 97 dozen.
[3] 770,087 shell oysters.
[4] 7 dozen.
[5] 70,387 dozen.
[6] 1,217,395 shell oysters.
[7] 1,551 dozen.
[8] 3 dozen.

CALIFORNIA FRESH FISHERY PRODUCTS FOR THE YEAR 1929—Continued

Species of fish	San Luis Obispo, Santa Barbara, Ventura	Los Angeles	Orange	San Diego, Imperial	Total	Fish from south of the International Boundary brought into California via San Pedro	Fish from south of the International Boundary brought into California via San Diego	Total fish from south of the International Boundary brought into California
Albacore		179,797	64	89,195	269,056		45	45
Anchovies		60,410	485		382,445			
Barracuda	3,793	2,883,259	159,467	879.352	3,925,899	1,007,628	295,083	1,302,711
Bonito	307	335,216	7,809	244,189	588,431	2,280,104	44,554	2,324,658
Carp					84,646			
Catfish					506,159			
Cultus Cod	419	2,220	903		1,158,150			
Eels		317			327			
Flounders	32	4,149	351		580,629		123	123
Grayfish	11,856	181,421	8,717	132,228	833,952	33		33
Hake					145,669			
Halibut	275,757	374,855	26,790	105,082	1,558,213	39,098	252,048	291,146
Hardhead					55,410			
Herring	325			4,488	957,563			
Kingfish		314,941	1,146	3,146	476,446		51	51
Mackerel	8,453	44,133,804	3,767,723	9,021,118	57,985,134		1,405	1,405
Mackerel—Horse		654,725	4,787		698,290	10,501		10,501
Mullet		4,611	133	25,775	30,519	18,028	16,047	34,075
Perch	9,799	92,834	556	230	310,516	678		678
Pike					3,259			
Pompano		2,032		256	2,790	19,735	2,913	22,648
Rock Bass	4,690	165,316	151,252	114,019	435,277	10,060	37,199	47,259
Rockfish	98,326	1,484,642	30,515	1,414,924	5,997,768	1,606	31,929	33,535
Sablefish	70	2,633	724		1,424,397			
Salmon					4,984,684			
Sandabs		15,214	164		1,051,868			
Sardines	5,315,130	278,053,346	906	3,929,383	651,771,904			
Sculpin	486	78,431	3,365	25,515	108,993			
Sea Bass—Black	1,401	48,446	13,407	100,839	164,093	46,891	193,227	240,118
Sea Bass—White	39,378	591,117	43,103	173,277	955,556	247,556	359,120	606,676
Shad					39,014			
Shad—Buck					631,277			
Shad—Roe					932,639			

Sheepshead	10,147	244,514	3,542	26,391	284,594	239	3,589	3,828
Skates	1,653	18,760	1,090	4,652	427,752		234	234
Skipjack		4,808,405	36	3,223,636	8,032,077	6,791,701	12,173,833	18,965,534
Smelt	43,767	381,980	64,092	16,672	912,730	567	704	1,271
Sole	142,888	66,048	2,641	8,162	11,705,545	910		910
Splittail					8,738			
Striped Bass					528,266			
Suckers					842			
Swordfish		186,047	776	505,484	692,307		774	774
Tomcod					15,884			
Tuna—Bluefin		5,763,588	25	1,262,528	7,026,141	10,210	40,277	50,487
Tuna—Yellowfin		150,239	10	49,195	199,444	11,876,516	25,287,334	37,163,850
Turbot					1,323			
Whitebait					242,919			
Whitefish	617	110,462	294	76,227	187,600	4,131	9,994	14,125
Yellowtail	17	105,343	2,383	742,202	849,945	1,187,054	975,718	2,162,772
Miscellaneous	162	94,312	2,572	288	351,034	95,288	155,342	250,630
Total fish	5,969,473	341,593,434	4,299,828	22,178,453	770,518,114	23,648,534	39,881,543	63,530,077
Crustaceans:								
Crabs					[9]1,792,776			
Shrimps					3,054,748			
Spiny Lobsters	50,185	198,186	25,423	122,970	396,764		1,034,908	1,034,908
Mollusks:								
Abalones	17,647				3,438,858	448,354		448,354
Clams—Cockle		17,125			65,466			
Clams—Mixed				85	13,498			
Clams—Pismo	100,221				109,714			
Clams—Softshell					101,460			
Cuttlefish	85	7	338		87,123			
Mussels					1,028			
Oysters—Eastern					[10]437,245			
Oysters—Native					61,962			
Squid		87,572			4,660,572			
Miscellaneous:								
Turtles				58	58		2,158	2,158
Totals	6,137,611	341,896,324	4,325,589	22,301,566	784,739,386	24,096,888	40,918,609	65,015,497

[9] 74,699 dozen.
[10] 1,987,482 shell oysters.

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1929

(Compiled by Division of Fish and Game, Bureau of Commercial Fisheries)

Canned

Kind of fish	Size of cans	Northern California district, cases	Monterey district, cases	San Pedro district, cases	San Diego district, cases	Total cases
Abalones	1-lb.			3,860		3,860
	½-lb.			205		205
Albacore	1-lb.			16,758	42	16,800
	½-lb.			107,354	2,250	109,604
	¼-lb.			3,286	134	3,420
	⅛-lb. (96 to case)			1,255		1,255
	7-oz. (24 to case)			1,559		1,559
Barracuda	1-lb.			1,773		1,773
	½-lb.			271		271
Bonito	1-lb.			1,630	1,097	2,727
	½-lb.			35,455	1,460	36,915
	¼-lb.			2,131	1,019	3,150
	¼-lb. (100 to case)			4,882		4,882
Mackerel	1-lb. tall		1,476	465,042	86,246	552,764
	1-lb. (24 to case)			25,057		25,057
	½-lb.			3,494	6,359	9,853
	½-lb. (72 to case)			20,280	810	21,090
	½-lb. (96 to case)			2,739		2,739
Salmon	½-lb. flat	5,503				5,503
Sardines	10-lb.		267			267
	1-lb. oval		2,039,526	1,438,159	12,225	3,489,910
	1-lb. tall		54,618	76,271	2,216	133,105
	¾-lb.			33,753		33,753
	½-lb. oval		15,413	8,072	1,228	24,713
	½-lb. oval B&P		1,206			1,206
	½-lb. square		11		2,105	2,116
	8-oz. (72 to case)		350			350
	5-oz. (100 to case)		75,101	168,039		243,140
	¼-lb. square		1,920		10,979	12,899
Shad	1-lb.	9,791				9,791
Shad roe	½-lb. oval	2,647				2,647
Squid	9-oz.		4,067			4,067
	7-oz.		2,489			2,489
Tonno	4-lb.			497		497
	1-lb.			308		308
	½-lb.			13,620	4,211	17,831
	¼-lb.			450	27,140	27,590
	¼-lb. (100 to case)			73,271		73,271
	¼-lb. (96 to case)			308		308
Tuna, bluefin	1-lb.			6,585	2,811	9,396
	½-lb.			46,577	17,803	64,380
	¼-lb.			12,252	2,023	14,275
	¼-lb. (100 to case)			866		866
	⅛-lb. (96 to case)			811		811
Tuna, striped	1-lb.			9,114	14,270	23,384
	½-lb.			88,694	169,826	258,520
	¼-lb.			18,428	24,248	42,676
	¼-lb. (100 to case)			12,200	10,352	22,552
Tuna, yellowfin	1-lb.			16,839	49,731	66,570
	½-lb.			119,469	313,930	433,399
	¼-lb.			16,125	94,956	111,081
	¼-lb. (100 to case)			1,690		1,690
	5½-oz. in glass				70	70
Tuna flakes	1-lb.			2,051	1,397	3,448
	½-lb.			5,552	8,673	14,225
	¼-lb.			104	836	940

CANNED, CURED AND MANUFACTURED FISHERY PRODUCTS OF CALIFORNIA FOR THE YEAR 1929

Canned—Continued

Kind of fish	Size of cans	Northern California district, cases	Monterey district, cases	San Pedro district, cases	San Diego district, cases	Total cases
Tuna, unclassified	4-lb.			1,024		1,024
	1-lb.			5,464		5,464
	½-lb.			28,362		28,362
	¼-lb.			2,793		2,793
	¼-lb. (100 to case)			7,526		7,526
Yellowtail	1-lb.			3,043	4,133	7,176
	½-lb.			2,802	2,352	5,154
	¼-lb.				2,966	2,966
Miscellaneous, scrap	1-lb.				7,345	7,345
	½-lb.				2,790	2,790
Totals		17,941	2,196,444	2,918,150	890,033	6,022,568

Salted, Smoked and Dried

Kind of fish	Size or quantity	Northern California district	Monterey district	San Pedro district	San Diego district	Total
Anchovies, salted	Pounds	1,450				1,450
Mixed fish, dried	Pounds	100,211				100,211
Mixed fish, salted	Pounds				168,567	168,567
Sablefish, smoked	Pounds	239,458				239,458
Salacchini	100-lbs.		69			69
Salacchini	50-lbs.		3,896			3,896
Salacchini	10-lbs.		117			117
Salmon, mild cured	Tierces	1,138	15			1,153
Salmon, smoked	Pounds	66,333				66,333
Sardines, salted	280-lb. bbls.		144			144
Sardines, salted	100-lb. bbls.		294			294
Sardines, salted	50-lb. kits		148			148
Sardines, salted	25-lb. kits		991			991
Sardines, smoked	Pounds	13,330				13,330
Shrimps, dried	Pounds	138,091				138,091
Shrimp meal	Pounds	265,400				265,400
Squid, dried	Pounds		541,914			541,914

Miscellaneous data

Fish flour	Tons		675			675
Fish meal	Tons	453	18,763	20,040	3,565	42,821
Fish oil	Gallons	18,926	4,186,192	2,280,991	62,017	6,548,126
Estimated value of pack		$583,670	$9,344,098	$14,492,141	$5,981,590	$30,401,499
Number of employees		505	2,516	3,457	1,210	7,688
Value of packing plants		$718,600	$3,053,037	$5,126,842	$778,628	$9,677,107
Number of packing plants		33	18	18	8	77

NOTE.—Sardines packed and fish meal and oil produced at Pittsburg included with Monterey.

REPORT OF SARDINE CANNERIES, SEASON 1929–30

Canning operations were started in Monterey on August 1, 1929, and in the San Pedro and San Diego districts on November 1, 1929. All plants at Monterey closed on February 15. However, small deliveries of fish used for packing in quarter-pound square cans were made to one plant after February 15. In the San Pedro and San Diego districts, all plants closed on March 31. One plant operated in Northern California and the output from this plant is included in the Monterey report. The following table shows receipts of fish, purposes for which used and production in the Monterey, San Pedro and San Diego districts:

CANNERY, FISH FLOUR, MEAL AND OIL PRODUCTION

August 1, 1929, to March 31, 1930

District	Tons fish received	Tons fish used for canning	Tons fish used for meal and flour	Tons offal
Monterey	180,089	108,674	71,351	36,237
San Pedro	140,432	97,602	42,830	32,532
San Diego	2,079	1,436	643	478
Totals	322,600	207,712	114,824	69,247
Deduct fish used for other purposes	24,508			
Fish used by canning plants	298,092			

District	Cases 1-lb. ovals packed	Cases other size cans packed	Other size cans equivalent to cases 1-lb. ovals	Cases per ton
Monterey	2,004,044	167,036	169,462	13.9
San Pedro	1,493,615	461,535	458,416	13.9
San Diego	16,551	13,640	12,552	14.0
Totals	3,514,210	642,211	640,430	

District	Fish flour, tons	Meal, tons	Ratio per ton of meal	Oil, gallons	Gallons oil per ton of fish and offal	Tons of fish used for other purposes
Monterey	654	18,953	5.4	4,362,002	40.5	[1]24,508
San Pedro	------------	16,258	4.6	1,986,704	26.3	------------
San Diego	------------	251	4.3	11,071	11.0	------------
Totals	654	35,462	------------	6,359,777	------------	24,508

[1] 10,383 tons used for fish flour, 14,032 tons used for edible oil, 93 tons for salting.

COMPARATIVE STATEMENT OF SARDINE CANNERY PRODUCTION, SEASONS 1928-29 AND 1929-30

Monterey District

	Season 1928-29	Season 1929-30	Increase 1929-30	Percentage increase
Tons fish received	131,859	180,089	48,230	36.6
Tons fish used for canning	81,773	108,674	26,901	32.9
Tons fish used for meal	49,635	71,351	21,716	43.7
Tons offal	27,267	36,237	8,970	32.9
Cases 1-lb. ovals packed	1,520,192	2,004,044	483,852	31.8
Cases other sizes packed	133,594	167,036	33,442	25.0
Other sizes equivalent to cases of 1-lb. ovals	115,664	169,462	53,798	46.5
Meal, tons	13,782	18,953	5,171	37.5
Oil, gallons	2,938,579	4,362,002	1,423,423	48.4
Tons fish used for other purposes	12,764	24,508	11,744	92.0

San Pedro District

	Season 1928-29	Season 1929-30	Increase 1929-30	Percentage increase
Tons fish received	119,180	140,432	21,252	17.8
Tons fish used for canning	65,702	97,602	31,900	48.5
Tons fish used for meal	53,478	42,830	*10,648	*19.8
Tons offal	21,901	32,532	10,631	48.5
Cases 1-lb. ovals packed	1,140,488	1,493,615	353,127	30.9
Cases other sizes packed	166,039	461,535	295,496	178.0
Other sizes equivalent to cases of 1-lb. ovals	173,540	458,416	284,876	164.1
Meal, tons	14,802	16,258	1,456	9.8
Oil, gallons	2,178,815	1,986,704	*192,111	*8.8
Tons fish used for other purposes	2,964	----------	*2,964	*100.0

*Decrease.

SARDINE CATCH IN TONS BY MONTHS DURING SEASON 1929-30

	Monterey and Northern California	San Pedro	San Diego
August, 1929	24,632	----------	----------
September	19,843	----------	----------
October	35,401	----------	368
November	25,867	28,726	149
December	22,849	28,832	63
January, 1930	29,187	23,080	149
February	22,310	28,385	652
March	----------	31,409	698
Totals	180,089	140,432	2,079

CASE PACK OF 1-Lb. OVALS BY MONTHS DURING SEASON 1929-30

	Monterey and Northern California	San Pedro	San Diego
August, 1929	298,658	----------	----------
September	235,842	----------	----------
October	416,289	----------	----------
November	288,200	325,269	280
December	233,126	317,277	----------
January, 1930	299,971	245,956	960
February	231,958	302,481	5,364
March	----------	302,632	9,947
Totals	2,004,044	1,493,615	16,551

SARDINE MEAL PRODUCTION IN TONS BY MONTHS, SEASON 1929-30

	Monterey and Northern California	San Pedro	San Diego
August, 1929	2,412		
September	2,030		
October	3,490		84
November	2,855	3,173	57
December	2,575	3,305	2
January, 1930	3,145	2,635	14
February	2,446	3,565	61
March		3,580	33
Totals	18,953	16,258	251

SARDINE OIL PRODUCTION IN GALLONS BY MONTHS, SEASON 1929-30

	Monterey and Northern California	San Pedro	San Diego
August, 1929	527,904		
September	464,115		
October	802,736		1,308
November	623,828	426,838	718
December	605,947	378,229	
January, 1930	766,210	292,743	100
February	571,262	486,329	4,579
March		402,565	4,366
Totals	4,362,002	1,986,704	11,071

PLANTS OPERATED, SEASON 1929-30

F. E. Booth Company, Inc.	Pittsburg
Bayside Fish Flour Company	Monterey
F. E. Booth Company, Inc.	Monterey
California Packing Corporation	Monterey
Carmel Canning Company	Monterey
Custom House Packing Corporation	Monterey
Del Mar Canning Corporation	Monterey
Globe Grain and Milling Company	Monterey
E. B. Gross Canning Company	Monterey
K. Hovden Company	Monterey
Monterey Canning Company	Monterey
Monterey Sardine Products Company	Monterey
San Carlos Canning Company	Monterey
San Xavier Fish Packing Company	Monterey
Sea Pride Packing Corporation, Ltd.	Monterey
Vegetable Oil Products Company, Inc.	Monterey
California Packing Corporation	Terminal Island
Coast Fishing Company	Wilmington
Franco-Italian Packing Company, Inc.	Terminal Island
French Sardine Company, Inc.	Terminal Island
General Fisheries Corporation	San Pedro
Italian Food Products Company, Inc.	Long Beach
Linde Packing Corporation	Wilmington
Sea Pride Packing Corporation, Ltd.	Wilmington
Southern California Fish Corporation	Terminal Island
Van Camp Sea Food Company, Inc.	Terminal Island
Ventura Packing Corporation	Hueneme
K. Hovden Company	Point Loma
San Diego Packing Company	Point Loma
Westgate Sea Products Company	San Diego

The following table shows case pack, meal and oil production for calendar years 1916 to 1929:

1-Lb. Ovals, Cases

Year	Monterey and Northern California	San Pedro district	San Diego district	Total
1916	97,100	2,512	7,133	106,745
1917	331,065	43,221	34,380	408,666
1918	593,315	136,632	17,790	747,737
1919	798,566	113,909	33,594	946,069
1920	687,777	213,714	50,302	951,793
1921	287,954	77,048	1,189	366,191
1922	353,188	340,860	3,595	697,643
1923	580,464	488,885	19,215	1,088,564
1924	631,286	693,133	12,135	1,336,554
1925	737,743	920,191	29,846	1,687,780
1926	1,158,133	861,088	63,410	2,082,631
1927	1,341,872	1,046,453	14,947	2,403,272
1928	1,511,535	945,676	39,755	2,496,966
1929	2,039,526	1,438,159	12,225	3,489,910

Fish Meal, Tons

Year	Monterey and Northern California	San Pedro district	San Diego district	Total
1916	249	261	25	535
1917	875	2,606	----------	3,481
1918	2,874	4,737	1,123	8,734
1919	3,812	5,667	1,674	11,153
1920	3,969	3,328	1,559	8,856
1921	2,115	3,566	616	6,317
1922	2,695	5,373	939	9,027
1923	3,806	4,216	1,256	9,238
1924	6,601	7,726	1,001	15,328
1925	7,105	13,023	2,808	22,936
1926	7,807	7,066	1,394	15,767
1927	9,347	9,746	2,018	21,111
1928	12,575	12,923	2,367	27,865
1929	19,216	20,040	3,565	42,821

Includes all meal produced.

Fish Oil, Gallons

Year	Monterey and Northern California	San Pedro district	San Diego district	Total
1916	25,563	----------	500	26,063
1917	92,393	83,900	----------	176,293
1918	261,466	67,858	17,400	346,724
1919	341,173	146,298	26,791	514,262
1920	419,474	152,937	39,174	611,585
1921	226,826	93,305	16,607	336,738
1922	295,858	244,310	6,882	547,050
1923	576,553	346,883	28,452	951,888
1924	1,240,296	1,059,001	51,425	2,350,722
1925	1,246,561	1,715,633	187,847	3,150,041
1926	1,418,512	651,006	54,410	2,123,928
1927	1,759,480	763,905	95,105	2,618,490
1928	2,456,716	1,268,518	24,068	3,749,302
1929	4,205,118	2,280,991	62,017	6,548,126

Includes all fish oil produced.

CASE PACK, MEAL AND OIL PRODUCTION

For Sardine Packing Seasons

1-Lb. Ovals, Cases

Season	Monterey and Northern California	San Pedro district	San Diego district	Total
1925-1926	940,906	968,495	66,074	1,975,475
1926-1927	1,202,516	986,858	------------	2,189,374
1927-1928	1,474,162	878,175	39,380	2,391,717
1928-1929	1,520,192	1,140,488	12,383	2,673,063
1929-1930	2,004,044	1,493,615	16,551	3,514,210

Fish Meal, Tons

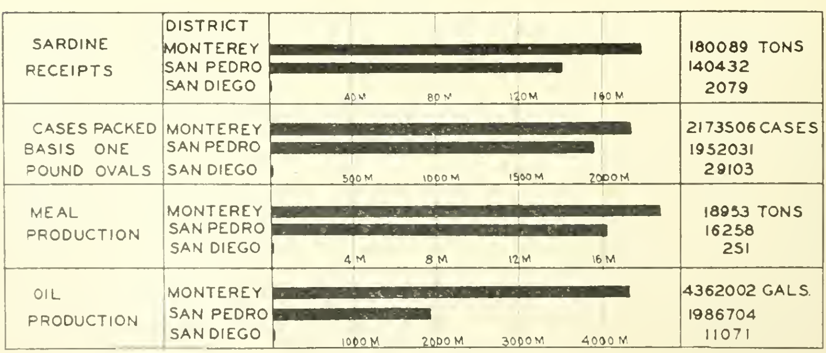
Season	Monterey and Northern California	San Pedro district	San Diego district	Total
1925-1926	6,413	5,962	467	12,842
1926-1927	6,675	5,962	------------	12,637
1927-1928	10,538	7,128	184	17,850
1928-1929	13,782	14,802	140	28,724
1929-1930	18,953	16,258	251	35,462

Fish Oil, Gallons

Season	Monterey and Northern California	San Pedro district	San Diego district	Total
1925-1926	1,113,612	658,817	43,995	1,816,424
1926-1927	1,562,351	682,796	------------	2,245,147
1927-1928	1,859,982	711,579	10,253	2,581,814
1928-1929	2,939,579	2,178,815	6,857	5,125,251
1929-1930	4,362,002	1,986,704	11,071	6,359,777

For quick reference and comparison of activities in the Monterey, San Pedro and San Diego districts, a chart is given below showing receipts of sardines, number of cases packed on basis of 1-lb. oval cans, number of tons of meal and gallons of oil produced.

FIG. 1



Season 1929–1930

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